SPECIFICATIONS

For: CANTAPORTS

Job Number: S853595

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Cantaports
Unit 2/9 Principal Place
MALAGA WA 6090

Dear Emmanuel

SERIES 4000, 5000, 5700, HAND CALCULATIONS AND PURLINS SPECIFICATIONS

Please find attached the specifications requested. Thank you for the opportunity to assist you in this matter. If this Office can be of further assistance or if clarification is needed on any comments in this report, please do not hesitate to contact us.

Yours faithfully

Ashley List
Project Engineer
BEng (Hons) DIS,. M.I.E (Aust)

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1. 4,000 SERIES

STATIC REPORT

PJR－series

4330-H23

2016. 09. 23

SankyoTateyama,Inc.

1. Material and Evaluation

①Post

Materi A6063S-T6(SS)

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N/mm2
DE8388	13.90	563.62	173.23	75.15	36.47	70000	3.53	180

Material evaluation (without support and side panel Vex=38m/s)

Snow for short period

$\sigma b/fb+\sigma c/fc=$ 0.62 ＜1.0 OK !

Wind blow up

$\sigma b/fb+\sigma c/fc=$ 0.62 ＜1.0 OK !

Wind blow down

$\sigma b/fb+\sigma t/ft=$ 0.70 ＜1.0 OK !

$2\cdot lk/i=$ 115.6 ＜140 OK !

②Beam

Materi A6063S-T6(SS)

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N/mm2
DE8393	9.06	231.70	60.75	37.37	18.13	70000	2.59	180

Material evaluation (without support and side panel Vex=38m/s)

Snow for short period

$\sigma b/fb=$ 0.70 ＜1.0 OK !

Wind blow up

$\sigma bx/fbx=$ 0.51 ＜1.0 OK !

Wind blow down

$\sigma bx/fbx=$ 0.68 ＜1.0 OK !

③Main frame

Materi A6063S-T6(SS)

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N/mm2
DE8579有	1.75	5.80	2.13	2.51	0.93	70000	1.10	180

Material evaluation

$\sigma b/fb=$ 0.42 ＜1.0 OK !

④Front frame

Materi A6063S-T5

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N/mm2
DE8401	2.55	12.50	6.91	3.81	2.20	70000	1.65	132

Material evaluation

$\sigma b/fb=$ 0.22 ＜1.0 OK !

⑤Rear frame

Materi A6063S-T5

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N/mm2
DE8404有	2.55	7.70	5.90	2.34	1.82	70000	1.52	132

Material evaluation

$\sigma b/fb=$ 0.30 ＜1.0 OK !

⑥Rafter

Materi A6063S-T5

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N/mm2
DE8654+DE8666	1.88	0.36	3.75	0.53	1.48	70000	1.41	132

Material evaluation

$\sigma b/fb=$ 0.47 <1.0 OK !

⑦Side frame

Materi A6063S-T5

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N/mm2
DE8683+DE8412	1.65	0.40	2.00	0.32	0.93	70000	1.10	132

Material evaluation

$\sigma b/fb=$ 0.33 <1.0 OK !

⑧Corner bracket

Materi SPFH590

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N/mm2
GB8064	8.58	205.21	65.07	28.12	20.34	210000	2.75	420

Material evaluation(without support and side panel Vex=38m/s)

$\sigma bx/fb=$ 0.52 <1.0 OK !

$\sigma by/fb=$ 0.08 <1.0 OK !

⑨Main frame connecting parts

Materi A6063S-T5

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N/mm2
GB8086	2.77	5.59	1.85	2.87	1.69	70000	0.82	132

Material evaluation

$\tau /fs=$ 0.01 <1.0 OK !

⑩Front frame connecting parts

Materi A6063S-T5

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N/mm2
GB8084	2.62	6.94	4.75	2.95	2.26	70000	1.35	132

Material evaluation

$\tau /fs=$ 0.01 <1.0 OK !

⑪Rear frame connecting parts

Materi A6063S-T5

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N/mm2
GB8085	1.92	2.92	1.83	1.78	1.40	70000	0.98	132

Material evaluation

$\tau /fs=$ 0.01 <1.0 OK !

⑫Roof material

Material polycarbonat

Material performance

Material	Thickness	Length(short part)	Length(long part)	Inserting	Poisson ratio	Elasticity factor	F value
	cm	cm	cm	cm	ν	kgf/cm2	kgf/cm2
GB4107	0.18	70.3	296.2	1.89	0.3	21000	551

Material evaluation

Bending volume : Wmax= 1.82 cm

max σ x= 44.44 kgf/cm^2 < 551.0 kgf/cm^2 ∴OK !

Necessary depth of insert ΔL 0.31 cm depth or < 1.89 cm ∴OK !

⑬Roof retainer

Materi A6063S-T5

Material performance

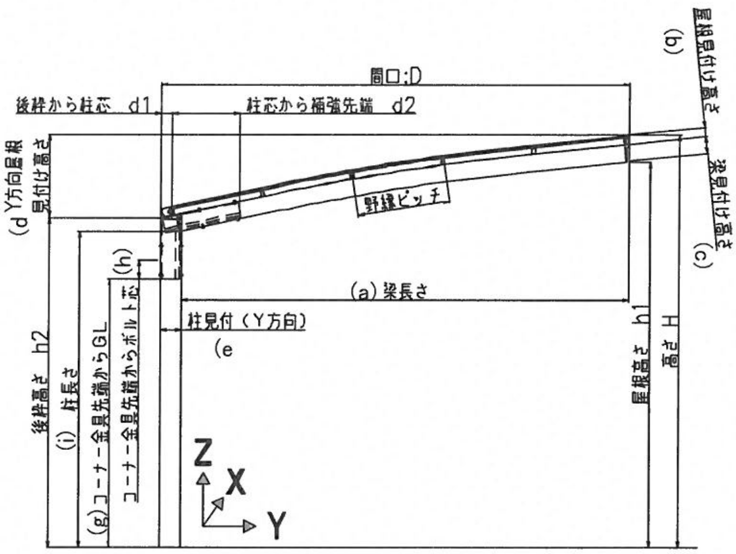
Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N/mm2
DE8411	0.79	0.03	1.84	0.08	0.72	70000	1.52	132

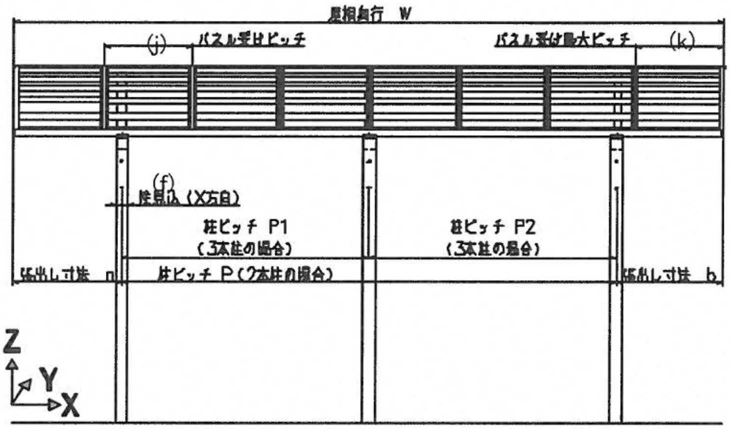
Material evaluation

σ b/fb= 0.18 <1.0 OK !

2. Carport detail

type	4330-H23
Roof projection A＝	12.94 m^2
Burden projection per post＝	6.47 m^2
Depth: D＝	3.000 m
Roof length: W＝	4.312 m
from rear frame to post core d1＝	0.075 m
om post core to reinforcing end d2＝	0.484 m
(a)Beam length＝	2.850 m
Overhang length b=	0.856 m
(b) Roof part thickness	2.600 m
(c) Beam thickness	0.856 m
(d) Y direction roof part height＝	0.065 m
(e) Post dimension(Y direction)＝	0.124 m
(f) Post dimension(X direction)＝	0.551 m
Overall Height(GL to Roof end) H＝	0.150 m
Overall Height(GL to Beam) h1＝	0.095 m
verall Height(GL to Rear frame) h2＝	2.899 m
om the end of corner bracket to GL=	2.710 m
orner bracket to the center of bolts=	2.348 m
(i) Post length＝	1.910 m
Post quantity＝	0.130 m
(j) Rafter pitch＝	2.250 m
(k) Rafter maximum span＝	2
(m) Main frame pitch＝	0.715 m
(s) Rafter maximum span＝	0.726 m
(t) Main frame pitch＝	0.585 m





3. Load design

①Vertical over load (G)

Part Weight

Roof	60.0 N/m^2
Post	36.8 N/m

②Snow over load

Post quantity	Snow area	Snow quantity	Unit weight	Short period snow period
2 posts type	General area	20 cm	30 $N/m^2/cm$	600 N/m^2

③ Wind blowing load(Vex=38m/s)

・For design of structure frame

Speed pressure $q=0.6E(Vex \cdot y)^2=$	708 N/m^2
Standard wind speed $Vex=$	38 m/s
$E=Er^2Gf=$	1.194
$Er=1.7(Zb/Z_G)^{\alpha}=$	0.691
Ground surface Div.	Ⅲ
Gust influence factor $Gf=$	2.5
$Zb=$	5
$Z_G=$	450
$\alpha=$	0.2
Installation period factor $y=$	0.827

・For roof material design

Average speed pressure $q'=0.6Er2(Vex \cdot y)^2=$	283 N/m^2

④Earthquake power

Earthquake power $Qi=Z \cdot Rt \cdot Ai \cdot Co \cdot Wi$

Area factor $Z=$	1.0
Vibration feature $Rt=$	1.0
Coat shear power distribution factor $Ai=$	1.0
Standard shear power factor $C_o=$	0.3

4. Preparing calculation

4-1 Carport load (For earthquake power calculation)

Roof	388	N
Post	83	N
Wi=	471	N

Earthquake power Qi=Z･Rt･Ai･Co･Wi= 141.2 N

4-2 Wind pressure power calculation (Maximum wind power pressure for 1 post)

･For design of structure frame

Wind factor		
Independent shed	10 °	
C=	0.60	(+pressure)
	-1.00	(-pressure)
	1.2	(Post flat power, side panel)

Wind pressureW=q C=	425 N/m^2	(Wind blow down)
	-708 N/m^2	(Wind blow up)
	849 N/m^2	(Flat)

･Roof material design

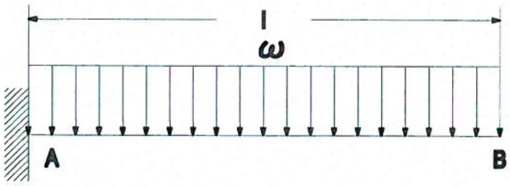
Peak with factor calculation process Gpe=	3.1	(+pressure)
	3.0	(-pressure: panel center part)
	4.0	(-pressure: panel surrounding part)

Peak wind factor Cf=	3.1	x	0.60	=	1.86
	3.0	x	-1.00	=	-3.00
	4.0	x	-1.00	=	-4.00

Wind pressure W=q' Cf=	527 N/m^2	(Wind blow down)
	-849 N/m^2	(Wind blow up)
	-1132 N/m^2	(Wind blow up)

5. Beam material examination

5-1 Beam load(without support Vex=38m/s)



Load chart

Type			
Vertical load width (m)	Total/post quantity		2.156
l (m)	D-d1-d2		2.441
Load ω(N/m)	Long period load		129.4
	Short period load		1423.0
	Short period blowing down(vertical)		1044.9
	Short period blowing up(vertical)		-1396.5
	Short period blowing down(horizontal)		133.8
	Short period earthquake(vertical)		129.4
	Short period earthquake(horizontal)		38.8
Bending moment M(N・m)	Long period load		385.4
	Short period load		4239.3
	Short period blowing down(vertical)		3113.0
	Short period blowing up(vertical)		-4160.6
	Short period blowing (horizontal)		398.5
	Short period earthquake(vertical)		385.4
	Short period earthquake(horizontal)		115.6
Maximum bending mom (N・m)	maxMx	(long period)	
		(short period)	4239.3
	maxMy	(long period)	
		(short period)	398.5
Second section mome	Ix(cm^4)		231.7
	Iy(cm^4)		60.7
Section factor	Zx(cm^3)		37.4
	Zy(cm^3)		18.1
Elasticity factor	E(N/cm^2)		7000000
Maximum bending stre (N/mm2)	max σx		113.4
	max σy		22.0
Vertical maximum defo	max δx	(cm)	3.89
	max δx/l	1/	111
Flat maximum deforma	max δy	(cm)	1.40
	max δy/l	1/	309

5-2 Beam permissible stress degree

Bending permissible stress degree

	Permissible stress degree for long period (N／mm2)	Permissible stress for short period(N/m3)
bλ≦bλp	F/ν	Long period x 1.5
bλp<bλ≦bλe	(1.0−0.5((bλ−bλp)/(bλe−bλp)))F/ν	Long period x 1.5
bλe<bλ	$(1/b\lambda^2)\cdot(F/\nu)$	Long period x 1.5

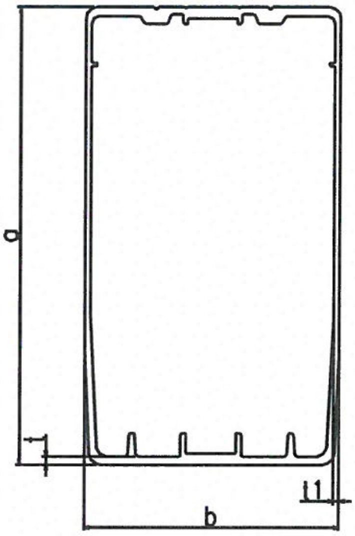
a=	12.40	cm
t=	0.38	cm
t1=	0.15	cm
b=	6.70	cm
Young's modulus factor E=	70000	N/mm^2
Shear elasticity factor of bending materialG=	27000	Nmm
Torsion fixed number of bending material=	127.3	cm^4
Second section moment around weak axis Iy=	60.745	cm^4
Section factor of bending direction Z=	37.37	cm^3
F:Standard strength(N／mm2)=	180	N/mm^2
$b\lambda=\sqrt{(My/Me)}$=	0.14	
$Me=C\sqrt{((\pi^2 EIyGJ)/lb^2)}$=	359491633	Nmm
Bending moment My=	6726600	Nmm
$C=1.75+1.05(M2/M1)+0.3(M2/M1)^2$=	1.75	
M2=	0	Nm
M1=	4161	Nm
M2/M1=	0	
lb=	584.7	mm
bλp=0.6+0.3(M2/M1)=	0.6	
$b\lambda e=1/\sqrt{0.5}$=	1.41	

$\nu=3/2+2(b\lambda/b\lambda e)^2/3$ (its value assumes 2.17 in case more than 2.17)

ν= 1.51

bλ≦bλp

Permissible stress degree fb: F／ν = 119.5 N/mm^2



NS 5030

Permissible stress degree at bend parts (strong axis)

1) Frange plate of beam <top/bottom face>

Γb : The conversion ratio = b/t・√(F/E)

Γb = 0.85

a) Γb ≦ 1.34 fb = F/1.5

b) 1.34 < Γb ≦ 2.69 fb = F − 0.248FΓb

c) 2.69 < Γb fb = 2.41 F/(Γb^2)

fb= 120.0 N/mm^2

---

2) Web plate of beam <side face>

Γd : The conversion ratio = d/t・√(F/E)

Γd = 3.94

a) Γd ≦ 3.29 fb = F/1.5

b) 3.29 < Γd ≦ 6.57 fb = F − 0.101FΓ

c) 6.57 < Γd fb = 14.4 F/(Γd^2)

fb= 108.5 N/mm^2

Therefore, result data is…

fbx= 108.5 N/mm^2

fbx= 162.7 N/mm^2

Permissible stress degree at bend parts (weak axis)

1) Frange plate of beam <top/bottom face>

Γb : = b/t・√(F/E)

Γb = 3.94

a) Γb ≦ 1.34 fb = F/1.5

b) 1.34 < Γb ≦ 2.69 fb = F − 0.248FΓb

c) 2.69 < Γb fb = 2.41 F/(Γb^2)

fb= 28.0 N/mm^2

---

2) Web plate of beam <side face>

Γd : The conversion ratio = d/t・√(F/E)

Γd = 0.85

a) Γd ≦ 3.29 fb = F/1.5

b) 3.29 < Γd ≦ 6.57 fb = F − 0.101FΓ

c) 6.57 < Γd fb = 14.4 F/(Γd^2)

fb= 120.0 N/mm^2

Therefore, result data is…

fby= 28.0 N/mm^2

fby= 42.0 N/mm^2

Section of the Beam examination

Snow for short period

M= 4239.3 N・m

σb= 113.4 N/mm^2

σb/fb= 0.70 **<1.0 OK !**

Wind blow down

M= 3113.0 N・m

σbx= 83.3 N/mm^2

σbx/fbx= 0.51 **<1.0 OK !**

Wind blow up

M= -4160.6 N・m

σbx= 111.3 N/mm^2

σbx/fbx= 0.68 **<1.0 OK !**

Wind blow horizontal

M= 398.5

σby= 22.0

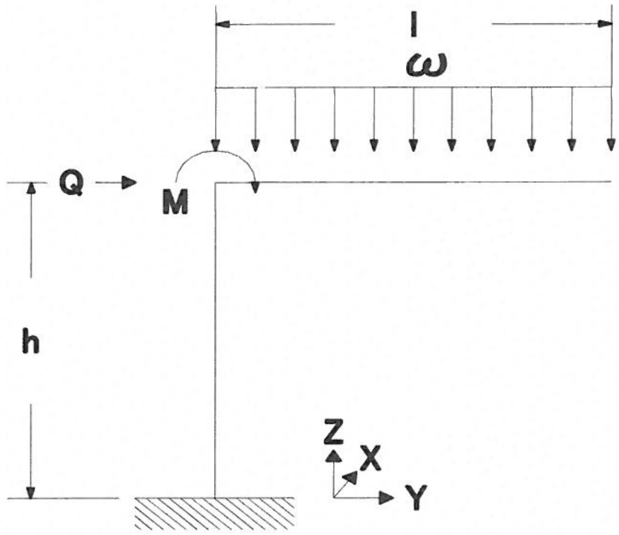
σby/fby= 0.52 **<1.0 OK !**

6. Post material examination

6-1 Post load

Load chart

Type		
Vertical load width (m)	Total/post quantity	2.156
l (m)	D-d1	2.850
Load ω(N/m)	Long period load	129.4
	Short period load	1423.0
	Short period blowing up(vertical)	1044.9
	Short period blowing down(vertical)	-1396.5
	Short period earthquake(vertical)	129.4
Axial force by vertical load N(N)	Long period load	470.8
	Short period load	4351.6
	Short period blowing up(vertical)	3217.4
	Short period blowing down(vertical)	-4106.8
	Short period earthquake(vertical)	470.8
Flat load Q(N)	Short period wind X	637.4
	Short period wind Y	840.6
	Short period earthquakeX、Y	116.4
Bending moment M(N・m)	Long period load	525.4
	Short period load	5779.0
	Short period blowing up(vertical)	4243.5
	Short period blowing down(vertical)	-5671.6
	Short period earthquake(vertical)	525.4
Bending moment by vertical and flat load Mx(N・m)	Short period blowing up(vertical)+WindY	6134.9
	Short period blowing down(vertical)+WindY	-7563.0
	Short period earthquake(vertical) + Earthquak	787.3
Bending moment by flat load My(N・m)	Short period windX	1434.2
	Short period earthquakeX	262.0
Maximum bending moment(N・m)	maxMx (long period)	
	(short period)	7563.0
	maxMy (short period wind)	1434.2
	(short period earthqua	262.0
Second section moment	Ix(cm4)	563.623
	Iy(cm4)	173.23
Section factor	Zx(cm3)	75.15
	Zy(cm3)	36.47
Max. bending stress deg. σx(N/mm2)	Long period load	6.99
	Short period load	76.90
	Short period blowing up(vertical)	56.47
	Short period blowing down(vertical)	-75.47
	Short period earthquake(vertical)	6.99
	Short period blowing up(vertical)+WindY	81.64
	Short period blowing down(vertical)+WindY	-100.64
	Short period earthquake(vertical) + Earthquak	10.48
max σx(N/mm2) (uniaxial bending)	Long period	6.99
	Short period(Y direction Vertical load)	100.64
Bending stress degree σy(N/mm2)	Short period windX	39.33
	Short period earthquakeX	7.18

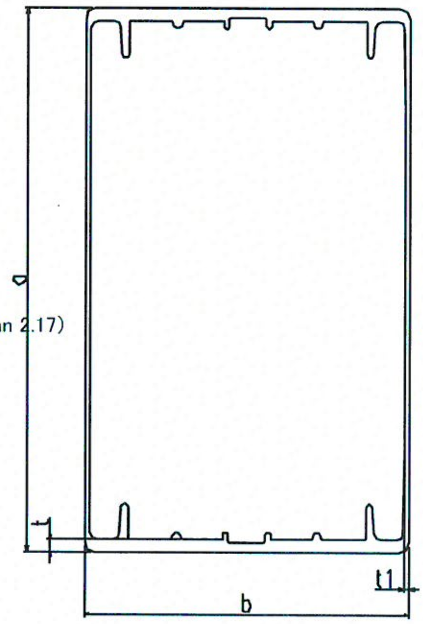


6-2 Post permissible stress degree

Permissible pressure stress degree

	Permissible stress degree for long period (N/mm2)	For short period(N/m3)
$c\lambda \leqq c\lambda p$	F/ν	Long period x 1.5
$c\lambda p < c\lambda \leqq c\lambda e$	$(1.0-0.5((c\lambda - c\lambda p)/(c\lambda e - c\lambda p)))F/\nu$	Long period x 1.5
$c\lambda e < c\lambda$	$(1/c\lambda^2)\cdot(F/\nu)$	Long period x 1.5

a=	15.00	cm
t=	0.44	cm
t1=	0.16	cm
b=	9.50	cm
$c\lambda=(lk/i)\sqrt{}(F/\pi^2E)=$	1.9	
lk: Buckling length (cm) =	407.96	cm
Standard strength F (N/mm2) =	180	N/mm^2
E: Young's modulus factor (N/mm2) =	70000	N/mm^2
$c\lambda p=$	0.2	
$c\lambda e=1/\sqrt{}0.5=$	1.41	
$\nu=3/2+2(c\lambda/c\lambda e)2/3$	(its value assumes 2.17 in case more than 2.17)	
$\nu=$	2.17	
H=	203.98	cm
Section second radius i (cm) =	3.53	cm
$c\lambda e < c\lambda$		
fc=	36.6	N/mm^2



Permissible stress degree at bend parts

1) Frange plate of beam <top/bottom face>

$\Gamma d := d/t \cdot \sqrt{}(F/E)$

$\Gamma d =$ 1.06

a) $\Gamma d \leqq 1.34$ fb $= F/1.5$

b) $1.34 < \Gamma d \leqq 2.69$ fb $= F - 0.248F\Gamma d$

c) $2.69 < \Gamma d$ fb $= 2.41\ F/(\Gamma d^2)$

fc= 120.0 N/mm^2

2) Web plate of beam <side face>

$\Gamma d := d/t \cdot \sqrt{}(F/E)$

$\Gamma d =$ 4.48

a) $\Gamma d \leqq 1.34$ fb $= F/1.5$

b) $1.34 < \Gamma d \leqq 2.69$ fb $= F - 0.248F\Gamma d$

c) $2.69 < \Gamma d$ fb $= 2.41\ F/(\Gamma d^2)$

fc= 21.7 N/mm^2

Therefore, result date is・・・

fc= 21.7 N/mm^2

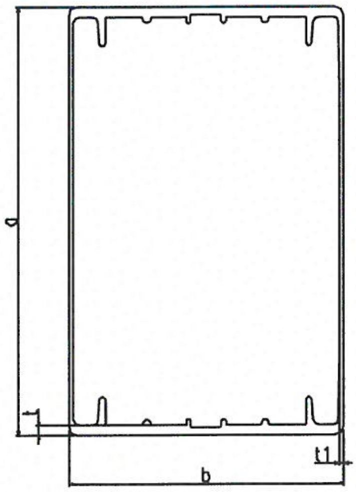
fc= 32.5 N/mm^2

6-3 Permissible stress degree at bend parts

Permissible bending stress degree

	Permissible stress degree for long period (N／mm2)	For short period(N/m3)
$b\lambda \leqq b\lambda p$	F/ν	Long period x 1.5
$b\lambda p < b\lambda \leqq b\lambda e$	$(1.0-0.5((b\lambda - b\lambda p)/(b\lambda e - b\lambda p)))F/\nu$	Long period x 1.5
$b\lambda e < b\lambda$	$(1/b\lambda^2)\cdot(F/\nu)$	Long period x 1.5

a=	15.00	cm
t=	0.44	cm
t1=	0.16	cm
b=	9.50	cm
Young's modulus factor E=	70000	N/mm^2
Shear elasticity factor of bending material G=	27000	Nmm
Torsion fixed number of bending material=	329.6	cm^4
Second section moment around weak axis Iy=	173.233	cm^4
Section factor of bending direction Z=	75.15	cm^3
F: Standard strength (N／mm2) =	180	N/mm^2
$b\lambda = \sqrt{(My/Me)}$=	0.28	
$Me = C\sqrt{((\pi^2 EIyGJ)/lb^2)}$=	170876462	Nmm
Bending moment My=	13527000	Nmm
$C=1.75+1.05(M2/M1)+0.3(M2/M1)^2$=	1	
M2=	-5671.6	Nm
M1=	5671.6	Nm
M2/M1=	-1	
lb=	1909.8	mm
$b\lambda p=0.6+0.3(M2/M1)$=	0.3	
$b\lambda e=1/\sqrt{0.5}$=	1.41	



$\nu = 3/2 + 2(b\lambda / b\lambda e)^2/3$ (its value assumes 2.17 in case more than 2.17)

ν = 1.53

$b\lambda \leqq b\lambda p$

Permissble stress degree fb: F/ν = 117.9 N/mm^2

Permissible bending stress degree (strong axis)

1) Frange plate <top/bottom face>

Γb :The conversion ratio = b/t・√(F/E)

Γb = 1.06

a) Γb ≦ 1.34	fc = F/1.5
b) 1.34 < Γb ≦ 2.69	fc = F − 0.248FΓb
c) 2.69 < Γb	fc = 2.41 F/(Γb2)

fb= 120.0 N/mm^2

2)Web plate <side face>

Γd : The conversion ratio = d/t・√(F/E)

Γd = 4.48

a) Γd ≦ 3.29	fb = F/1.5
b) 3.29 < Γd ≦ 6.57	fb = F − 0.101FΓd
c) 6.57 < Γd	fb = 14.4 F/($Γd^2$)

fb= 98.6 N/mm^2

Therefore, result date is・・・

fbx= 98.6 N/mm^2

fbx= 148.0 N/mm^2

Permissible bending stress degree (weak axis)

1) Frange plate <top/bottom face>

Γb :The conversion ratio = b/t・√(F/E)

Γb= 4.48

a) Γb ≦ 1.34	fc = F/1.5
b) 1.34 < Γb ≦ 2.6 9	fc = F − 0.248FΓd
c) 2.69 < Γb	fc = 2.41 F/(Γd2)

fb= 21.7 N/mm^2

2) Web plate <side face>

Γd : The conversion ratio = d/t・√(F/E)

Γd= 1.06

a) Γd ≦ 3.29	fb = F/1.5
b) 3.29 < Γd ≦ 6.57	fb = F − 0.101FΓd
c) 6.57 < Γd	fb = 14.4 F/($Γd^2$)

fb= 120.0 N/mm^2

Therefore, result date is・・・

fby= 21.7 N/mm^2

fby= 32.5 N/mm^2

Examination of the section of the post

Short period snow load

σb= 76.9 N/mm^2

σc=N/A= 3.1 N/mm^2

σb/fb+σc/fc= 0.62 <1.0 OK !

Wind blow down

σb= 81.6 N/mm^2

σc=N/A= 2.3 N/mm^2

σb/fb+σc/fc= 0.62 <1.0 OK !

Wind blow up

σb= 100.6 N/mm^2

σt=N/A= 3.0 N/mm^2

σb/fb+σt/ft= 0.70 <1.0 OK !

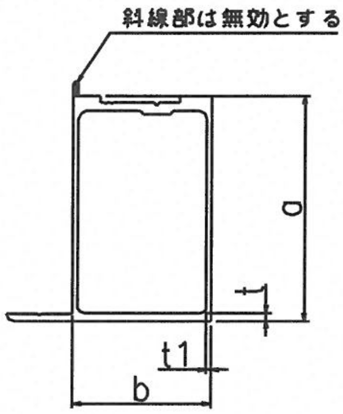
2・lk/i= 115.6 <140 OK !

7. Main Frame Bending permissible stress degree

7-1 Bending permissible stress degree

	Permissible stress degree for long period (N／mm2)	Permissible stress for short period(N/m3)
$b\lambda \leqq b\lambda p$	F/ν	Long period x 1.5
$b\lambda p < b\lambda \leqq b\lambda e$	$(1.0-0.5((b\lambda - b\lambda p)/(b\lambda e - b\lambda p)))F/\nu$	Long period x 1.5
$b\lambda e < b\lambda$	$(1/b\lambda^2)\cdot(F/\nu)$	Long period x 1.5

a=	4.60	cm
t=	0.11	cm
t1=	0.09	cm
b=	2.50	cm
Young's modulus factor E=	70000	N/mm^2
Shear elasticity factor of bending materialG＝	27000	Nmm
Torsion fixed number of bending material＝	3.3	cm^4
Second section moment around weak axis Iy=	2.126	cm^4
Section factor of bending direction Z=	2.512	cm^3
F：Standard strength(N／mm2)＝	180	N/mm^2
$b\lambda=\sqrt{(My/Me)}$=	0.28	
$Me=C\sqrt{((\pi 2EIyGJ)/lb2)}$=	5684039	Nmm
Bending moment My=	452160	Nmm
C=	1.13	
lb=	715	mm
$b\lambda p=0.6+0.3(M2/M1)$=	0.3	
$b\lambda e=1/\sqrt{0.5}$=	1.41	



$\nu=3/2+2(b\lambda/b\lambda e)^2/3$ (its value assumes 2.17 in case more than 2.17)

ν＝ 1.53

$b\lambda \leqq b\lambda p$

fb= 117.9 N/mm^2

Permissible stress degree at bend parts

1) Frange plate of beam <top/bottom face>

Γb ：The conversion ratio ＝ $b/t\cdot\sqrt{(F/E)}$

Γb＝ 0.41

a) Γb ≦ 0.438 　fb ＝ F/1.5

b) 0.438 ＜ Γb ≦ 0.876 　fb ＝ F － 0.760FΓb

c) 0.876 ＜ Γb 　fb ＝ $0.256\ F/(\Gamma b^2)$

fb= 120.0 N/mm^2

Γb ：The conversion ratio ＝ $b/t\cdot\sqrt{(F/E)}$

Γb＝ 1.07

a) Γb ≦ 1.34 　fc ＝ F/1.5

b) 1.34 ＜ Γb ≦ 2.69 　fc ＝ F － 0.248FΓd

c) 2.69 ＜ Γb 　fc ＝ 2.41 F/(Γd2)

fb= 120.0 N/mm^2

2) Wave plate of beam <side face>

Γb ：The conversion ratio ＝ $b/t\cdot\sqrt{(F/E)}$

Γd＝ 2.47

a) Γd ≦ 3.29 　fb ＝ F/1.5

b) 3.29 ＜ Γd ≦ 6.57 　fb ＝ F － 0.101FΓ

c) 6.57 ＜ Γd 　fb ＝ $14.4\ F/(\Gamma d^2)$

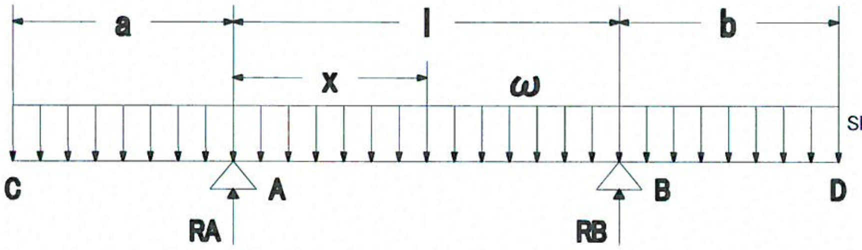
fb= 120.0 N/mm^2

Therefore, result data is…

fb= 117.9 N/mm^2

fb= 176.9 N/mm^2

7-2 Calculation of Main Frame Section



Parts Width=	0.585 m
Long period ω=	35.1 N/m
Short period load ω=	385.9 N/m
Short period blow up ω=	283.4 N/m
Short period blow down ω=	378.7 N/m
ω=	385.9 N/m
a=	0.9 m
l=	2.6 m
b=	0.9 m
x=	1.3 m
Z=	2.512 cm^3
I=	5.802 cm^4
E=	7000000 N/cm^2

W=Full-Load　M=Bend Moment
R=Anti-Power　θ=Rotation Angle
Q=Shear Power　δ=Bend

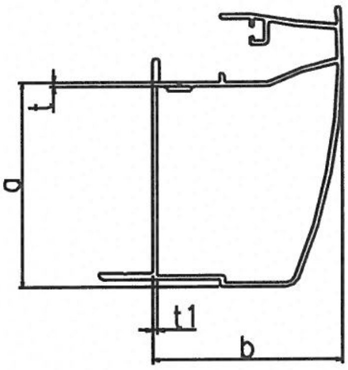
$W = w(a+l+b)$	=	1664.0 N
$RA = (w(a+l)^2 - wb^2)/2l$	=	832.0 N
$RB = (w(b+l)^2 - wa^2)/2l$	=	832.0 N
$QA = RA - wa$	=	501.7 (A,B material)
$QB = wb - RB$	=	-501.7 (A,B material)
$MA = -(wa^2/2)$	=	-141.4 N·m
$\sigma A = MA/Z$	=	56.3 N/mm^2
$MB = -(wb^2/2)$	=	-141.4 N·m
$\sigma B = MB/Z$	=	56.3 N/mm^2
$MX = RA \cdot x - w(a+x)^2/2$	=	184.7 (A,B material)
$\sigma X = MX/Z$	=	73.5 N/mm^2
$\sigma b/fb$	=	0.42 ＜1.0　OK !

8. Front frame bending permissible stress degree

8-1 Bending permissible stress degree

	Permissible stress degree for long period (N/mm2)	Permissible stress for short period(N/m3)
$b\lambda \leqq b\lambda p$	F/ν	Long period x 1.5
$b\lambda p < b\lambda \leqq b\lambda e$	$(1.0-0.5((b\lambda - b\lambda p)/(b\lambda e - b\lambda p)))F/\nu$	Long period x 1.5
$b\lambda e < b\lambda$	$(1/b\lambda^2)\cdot(F/\nu)$	Long period x 1.5

a=	4.77	cm
t=	0.10	cm
t1=	0.10	cm
b=	4.20	cm
Young's modulus factor E=	70000	N/mm^2
Shear elasticity factor of bending materialG=	27000	Nmm(アルミ材)
Torsion fixed number of bending material=	8.4	cm^4
Second section moment around weak axis Iy=	6.911	cm^4
Section factor of bending direction Z=	3.805	cm^3
F: Standard strength(N/mm2)=	132	N/mm^2
$b\lambda=\sqrt{}(My/Me)$=	0.17	
$Me=C\sqrt{}((\pi 2EIyGJ)/lb2)$=	16407392	Nmm
Bending moment My=	502260	Nmm
C=	1.13	
lb=	715	mm
$b\lambda p=0.6+0.3(M2/M1)$=	0.3	
$b\lambda e=1/\sqrt{0.5}$=	1.41	



$\nu=3/2+2(b\lambda/b\lambda e)^2/3$ (its value assumes 2.17 in case more than 2.17)

ν= 1.51

$b\lambda \leqq b\lambda p$

fb= 87.4 N/mm^2

Permissible stress degree at bend parts

1) Frange plate of beam <top/bottom face>

Γb : The conversion ratio = b/t・$\sqrt{}$(F/E)

Γb = 1.74

a) Γb ≦ 1.34 fc = F/1.5

b) 1.34 < Γb ≦ 2.69 fc = F − 0.248FΓd

c) 2.69 < Γb fc = 2.41 F/(Γd2)

fb= 75.1 N/mm^2

2) Web plate of beam <side face>

Γd = d/t・$\sqrt{}$(F/E)

Γd = 1.98

a) Γd ≦ 3.29 fb = F/1.5

b) 3.29 < Γd ≦ 6.57 fb = F − 0.101FΓ

c) 6.57 < Γd fb = 14.4 F/($Γd^2$)

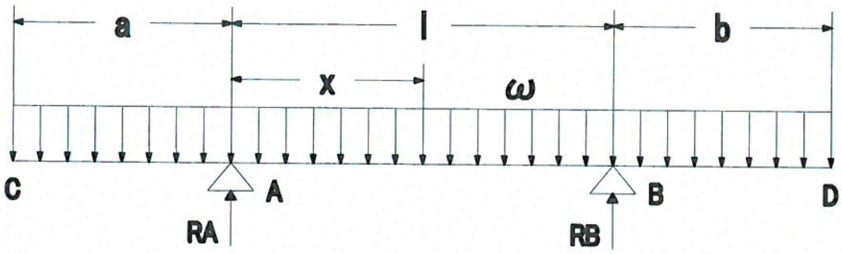
fb= 88.0 N/mm^2

Therefore, result data is…

fb= 75.1 N/mm^2

fb= 112.7 N/mm^2

8-2 Calculation of Front Frame Section



Parts Width=	0.292 m
Long period ω=	17.5 N/m
Short period load ω=	193.0 N/m
Short period blow up ω=	141.7 N/m
Short period blow down ω=	189.4 N/m
ω=	193.0 N/m
a=	0.9 m
l=	2.6 m
b=	0.9 m
x=	1.3 m
Z=	3.805 cm^3
I=	12.495 cm^4
E=	7000000 N/cm^2

W=Full-Load M=Bend Moment
R=Anti-Power θ=Rotation Angle
Q=Shear Power δ=Bend

W= w(a+l+b)	=	832.0 N
RA= $(w(a+l)^2-wb^2)/2l$	=	416.0 N
RB= $(w(b+l)^2-wa^2)/2l$	=	416.0 N
QA= RA-wa	=	250.8 (A,B material)
QB= wb-RB	=	-250.8 (A,B material)
MA= $-(wa^2/2)$	=	-70.7 N·m
σA= MA/Z	=	18.6 N/mm^2
MB= $-(wb^2/2)$	=	-70.7 N·m
σB= MB/Z	=	18.6 N/mm^2
MX= $RA\cdot x-w(a+x)^2/2$	=	92.4 (A,B material)
σX= MX/Z	=	24.3 N/mm^2
σb/fb	=	0.22 <1.0 OK !

9. **Bending permissible stress degree at rear frame**

9-1 Calculation method of effective section

Γb = b/t・√(F/E) = 0.438　　Therefore…

b/t = 0.438/√(F/E) = 10.09

Effective Depth

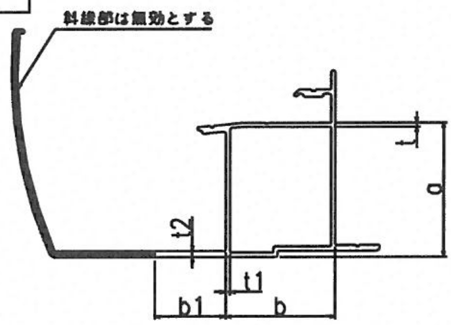
t2=	1.70	mm
b1=	17.15	mm

9-2. Bending permissible stress degree at rear frame

Bending permissible stress degree

	Permissible stress degree for long period (N／mm2)	Permissible stress for short period(N/m3)
bλ≦bλp	F/ν	Long period x 1.5
bλp<bλ≦bλe	(1.0−0.5((bλ−bλp)/(bλe−bλp)))F/ν	Long period x 1.5
bλe<bλ	$(1/b\lambda^2)\cdot(F/\nu)$	Long period x 1.5

a=	3.82	cm
t=	0.12	cm
t1=	0.12	cm
b=	2.95	cm
Young's modulus factor E=	70000	N/mm^2
Shear elasticity factor of bending materialG＝	27000	Nmm
Torsion fixed number of bending material＝	4.0	cm^4
Second section moment around weak axis Iy=	7.702	cm^4
Section factor of bending direction Z=	2.344	cm^3
F:Standard strength(N／mm2)＝	132	N/mm^2
bλ=√(My/Me)=	0.16	
$Me=C\sqrt{((\pi^2 EIyGJ)/lb^2)}$=	12025195	Nmm
Bending moment My=	309408	Nmm
C=	1.13	
lb=	715	mm
bλp=0.6+0.3(M2/M1)=	0.3	
bλe=1/√0.5=	1.41	



$\nu=3/2+2(b\lambda/b\lambda e)^2/3$ (its value assumes 2.17 in case more than 2.17)

ν= 1.51

bλ≦bλp

fb= 87.5 N/mm^2

Permissible stress degree at bend parts

1) Frange plate of beam <top/bottom face>

Γb : The conversion ratio ＝ b/t・√(F/E)

Γb = 0.98

a) Γb ≦ 1.34　　fc ＝ F/1.5

b) 1.34 ＜ Γb ≦ 2.69　　fc ＝ F − 0.248FΓd

c) 2.69 ＜ Γb　　fc ＝ 2.41 F/(Γd2)

fb= 88.0 N/mm^2

2) Web plate of beam <side face>

Γd = d/t・√(F/E)

Γd = 1.30

a) Γd ≦ 3.29　　fb ＝ F/1.5

b) 3.29 ＜ Γd ≦ 6.57　　fb ＝ F − 0.101FΓ

c) 6.57 ＜ Γd　　fb ＝ 14.4 F/(Γd^2)

fb= 88.0 N/mm^2

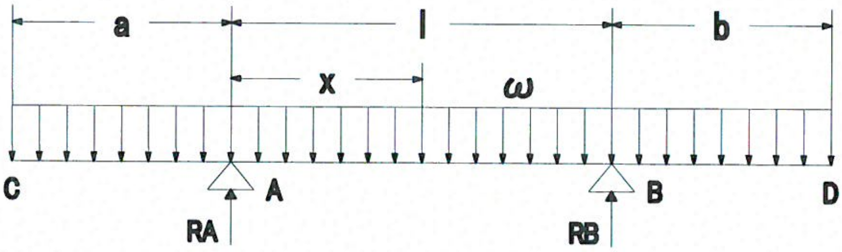
Therefore, result data is…

fb= 87.5 N/mm^2

fb= 131.2 N/mm^2

9-3 Calculation of Rear Frame Section

Parts Width＝ 0.292 m



Long period ω=	17.5 N/m
Short period load ω=	193.0 N/m
Short period blow up ω=	141.7 N/m
Short period blow down ω=	189.4 N/m
ω=	193.0 N/m

W=Full-Load M=Bend Moment
R=Anti-Power θ=Rotation Angle
Q=Shear Power δ=Bend

a=	0.9 m
l=	2.6 m
b=	0.9 m
x=	1.3 m
Z=	2.344 cm^3
I=	7.702 cm^4
E=	7000000 N/cm^2

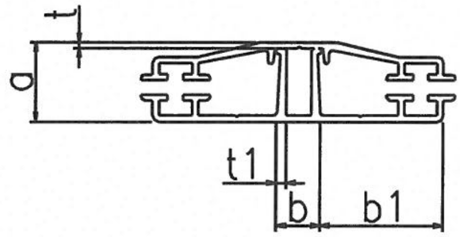
W= w(a+l+b)	=	832.0 N
RA= $(w(a+l)^2-wb^2)/2l$	=	416.0 N
RB= $(w(b+l)^2-wa^2)/2l$	=	416.0 N
QA= RA-wa	=	250.8 (A,B material)
QB= wb-RB	=	-250.8 (A,B material)
MA= $-(wa^2/2)$	=	-70.7 N・m
σA= MA/Z	=	30.2 N/mm^2
MB= $-(wb^2/2)$	=	-70.7 N・m
σB= MB/Z	=	30.2 N/mm^2
MX= $RA \cdot x-w(a+x)^2/2$	=	92.4 (A,B material)
σX= MX/Z	=	39.4 N/mm^2

σb/fb = 0.30 ＜1.0 OK !

10. Rafter / Roof retainer bending permissible stress degree

10-1 Bending permissible stress degree

a=	1.30	cm
t=	0.10	cm
t1=	0.17	cm
b=	0.72	cm
b1=	1.99	cm
Young's modulus factor E=	70000	N/mm^2
Shear elasticity factor of bending materialG=	27000	Nmm
Second section moment around weak axis Iy=	0.364	cm^4
Section factor of bending direction Z=	0.529	cm^3
F: Standard strength (N／mm2) =	132	N/mm^2



Therefore…

fb= 88.0 N/mm^2

Permissible stress degree at bend parts

Frange plate of beam <top/bottom face>

Γb : The conversion ratio = b/t · √(F/E)

Γb = 0.86

a) Γb ≦ 0.438	fb = F/1.5
b) 0.438 < Γb ≦ 0.876	fb = F − 0.760FΓb
c) 0.876 < Γb	fb = 0.256 F/(Γb2)
	fb= 45.3 N/mm^2

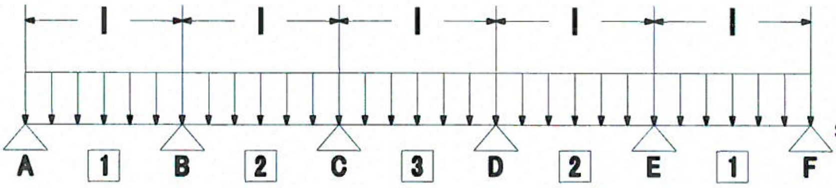
Therefore…

fb= 45.3 N/mm^2

fb= 68.0 N/mm^2

10-2 Calculation of Rafter / Roof retainer section

Parts Width=	0.715 m
l=	0.585 m



Long period ω=	42.9 N/m
Short period load ω=	471.9 N/m
Short period blow up ω=	346.5 N/m
Short period blow down ω=	-463.1 N/m
ω=	471.9 N/m
Z=	0.529 cm^3
I=	0.364 cm^4
E=	7000000 N/cm^2

W=Full-Load M=Bend Moment
R=Anti-Power θ=Rotation Angle
Q=Shear Power δ=Bend

	ωl	=	275.9 N
RA=	0.395 * ωl	=	109.0 N
RB=	1.131 * ωl	=	312.1 N
RC=	0.974 * ωl	=	268.7 N
RD=	0.974 * ωl	=	268.7 N
RE=	1.131 * ωl	=	312.1 N
RF=	0.395 * ωl	=	109.0 N
Rmax=			312.1 N
MB=	$-0.105 * ωl^2$	=	-16.9 N·m
MC=	$-0.079 * ωl^2$	=	-12.7 N·m
MD=	$-0.079 * ωl^2$	=	-12.7 N·m
ME=	$-0.105 * ωl^2$	=	-16.9 N·m
M1=	$0.078 * ωl^2$	=	12.6 N·m
M2=	$0.033 * ωl^2$	=	5.3 N·m
M3=	$0.046 * ωl^2$	=	7.4 N·m
σX=	MX/Z	=	32.0 N/mm^2
	σb/fb	=	0.47 <1.0 OK !

11. Side frame bending permissible stress degree

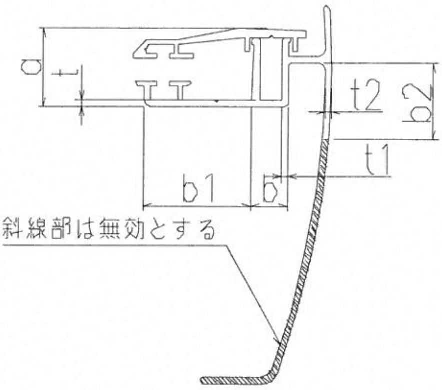
11-1 Calculation method of effective section

Γb = b/t・$\sqrt{(F/E)}$ = 0.438　　Therefore…

b/t = 0.438/$\sqrt{(F/E)}$ = 10.09

Effective Depth

t2=	1.20	mm
b2=	12.10	mm



11-2 Bending permissible stress degree

a=	1.30	cm
t=	0.11	cm
t1=	0.17	cm
b=	0.72	cm
b1=	1.99	cm
Young's modulus factor E=	70000	N/mm^2
ear elasticity factor of bending materialG=	27000	Nmm
cond section moment around weak axis Iy=	2	cm^4
Section factor of bending direction Z=	0.324	cm^3
F:Standard strength(N／mm2)=	132	N/mm^2

Therefore…

fb= 88.0 N/mm^2

Permissible stress degree at bend parts

Frange plate of beam <top/bottom face>

Γb : The conversion ratio = b/t・$\sqrt{(F/E)}$

Γb = 0.79

a) Γb ≦ 0.438　　fb = F/1.5

b) 0.438 < Γb ≦ 0.876　　fb = F − 0.760FΓb

c) 0.876 < Γb　　fb = 0.256 F/(Γb2)

fb= 53.2 N/mm^2

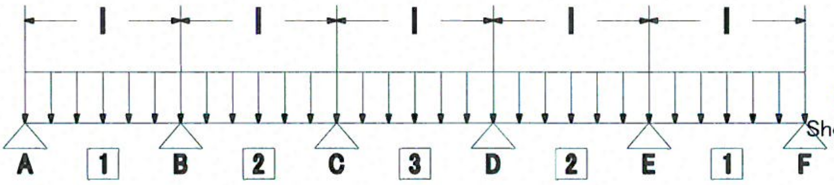
Therefore…

fb= 53.2 N/mm^2

fb= 79.8 N/mm^2

11-3 Calculation of Side frame secton

Parts Width=	0.363	m
l=	0.585	m
Long period ω=	21.8	N/m
Short period load ω=	239.6	N/m
Short period blow up ω=	175.9	N/m
Short period blow down ω=	-235.1	N/m
ω=	239.6	N/m
Z=	0.324	cm^3
I=	0.399	cm^4
E=	7000000	N/cm^2

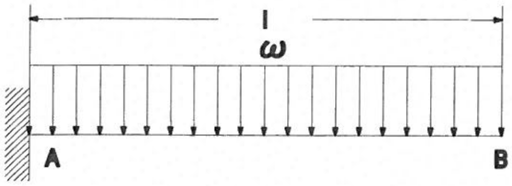


W=Full-Load　M=Bend Moment
R=Anti-Power　θ=Rotation Angle
Q=Shear Power　δ=Bend

	ωl	=	140.1	N
RA=	0.395 ＊ ωl	=	55.3	N
RB=	1.131 ＊ ωl	=	158.4	N
RC=	0.974 ＊ ωl	=	136.4	N
RD=	0.974 ＊ ωl	=	136.4	N
RE=	1.131 ＊ ωl	=	158.4	N
RF=	0.395 ＊ ωl	=	55.3	N
Rmax=			158.4	N
MB=	-0.105 ＊ ωl^2	=	-8.6	N･m
MC=	-0.079 ＊ ωl^2	=	-6.5	N･m
MD=	-0.079 ＊ ωl^2	=	-6.5	N･m
ME=	-0.105 ＊ ωl^2	=	-8.6	N･m
M1=	0.078 ＊ ωl^2	=	6.4	N･m
M2=	0.033 ＊ ωl^2	=	2.7	N･m
M3=	0.046 ＊ ωl^2	=	3.8	N･m
σX=	MX/Z	=	26.5	N/mm^2
	σb/fb	=	0.33	＜1.0　OK !

12. Corner bracket examination

12-1 Beam load



Load chart

Type		
Vertical load width (m)	Total/post quantity	2.156
l (m)	D-d1-d2	2.925
Load ω(N/m)	Long period load	129.4
	Short period load	1423.0
	Short period blowing up(vertical)	1044.9
	Short period blowing up(vertical)	-1267.2
	Short period blowing down(horizontal)	160.5
	Short period earthquake(vertical)	129.4
	Short period earthquake(horizontal)	38.8
Bending moment M(N・m)	Long period load	553.4
	Short period load	6087.2
	Short period blowing down(vertical)	4469.8
	Short period blowing up(vertical)	-5420.7
	Short period blowing (horizontal)	686.6
	Short period earthquake(vertical)	553.4
	Short period earthquake(horizontal)	166.0
Maximum bending momen (N・m)	maxMx (long period)	
	(short period)	6087.2
	maxMy (long period)	
	(short period)	686.6
Second section moment	Ix(cm^4)	231.7
	Iy(cm^4)	60.7
Section factor	Zx(cm^3)	37.4
	Zy(cm^3)	18.1
Elasticity factor	E(N/cm^2)	21000000
Maximum bending stress degree (N/mm2)	max σx	162.9
	max σy	37.9
Vertical maximum deformation quantity	max δx (cm)	2.68
	max δx/l 1/	161
Flat maximum deformation quantity	max δy (cm)	1.15
	max δy/l 1/	375

12-2 Calculation of Corner bracket Section

Material	Second section moment		Section factor	
	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)
GB8064	205.211	65.073	28.119	20.335

fb= 420 N/mm^2

Mx= 6087.2 N・m

My= 686.6 N・m

σbx= 216.5 N/mm^2

σby= 33.8 N/mm^2

σbx/fb= 0.52 <1.0 OK !

σby/fb= 0.08 <1.0 OK !

13. Examination of main frame connecting part

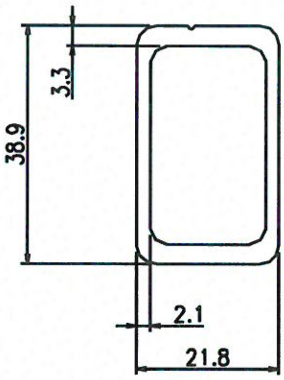
13-1 Calculation of Load

・Anti-Power of rafter

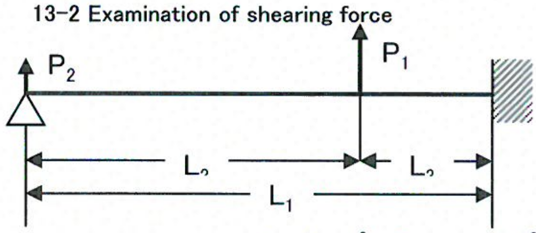
P_1= P1= 312.1 N ←from "Calculation of rafter"

・Anti-Power of connecting rafter

P_2= P2= 156.0 N ←(Anti-Power of rafter)/2



13-2 Examination of shearing force



L_1(m)	0.86
L_2(m)	0.715
L_3(m)	0.14
A(mm^2)	276.8
fs(N/mm^2)	76.2

$Q=(P_1\cdot L_3^2)\cdot(3L_2+2L_3)/(2L_1^3)+P_2$ より

Q= 168.0 N

$\tau=Q/A$= 0.61 N/mm^2

τ/fs= 0.01 ＜1.0 OK !

14. Examination of front frame connecting part

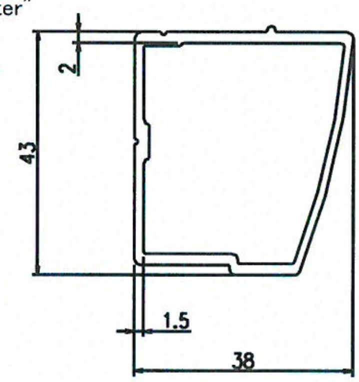
14-1 Calculation of Load

・Anti-Power of rafter

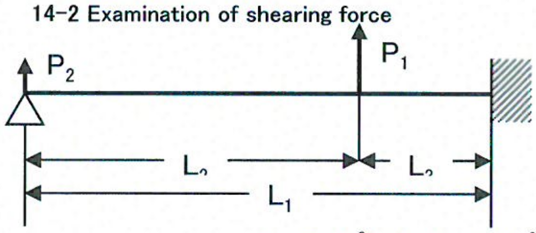
P_1= P1= 109.0 N ←from "Calculation of rafter"

・Anti-Power of connecting rafter

P2= 54.5 N ←(Anti-Power of rafter)/2



14-2 Examination of shearing force



L_1(m)	0.86
L_2(m)	0.715
L_3(m)	0.14
A(mm^2)	261.6
fs(N/mm^2)	76.2

$Q=(P_1\cdot L_3^2)\cdot(3L_2+2L_3)/(2L_1^3)+P_2$ より

Q= 58.7 N

$\tau=Q/A$= 0.22 N/mm^2

τ/fs= 0.01 ＜1.0 OK !

15. Examination of gutter connecting part

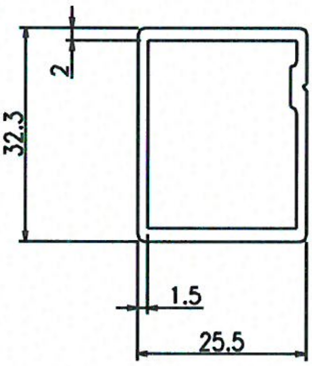
15-1 Calculation of Load

・Anti-Power of rafter

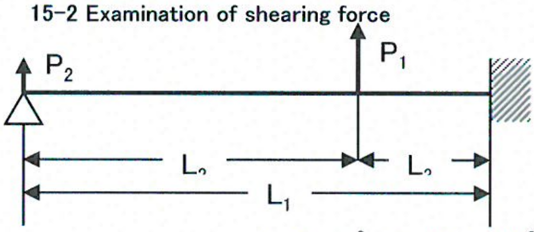
P_1= P1= 109.0 N ←from "Calculation of rafter"

・Anti-Power of connecting rafter

P_2= P2= 54.5 N ←(Anti-Power of rafter)/2



15-2 Examination of shearing force



L_1(m)	0.86
L_2(m)	0.715
L_3(m)	0.14
A(mm^2)	192.1
fs(N/mm^2)	76.2

$Q=(P_1\cdot L_3^2)\cdot(3L_2+2L_3)/(2L_1^3)+P_2$ より

Q= 58.7 N

$\tau=Q/A$= 0.31 N/mm^2

τ/fs= 0.01 ＜1.0 OK !

16. Examination of main frame and beam connection

16-1 Examination of screw pull-out force

・Pull-out force/screw

T= 416.0 N

・Stretching permissible stress

$ft= 2.1 \cdot \beta \cdot ((d^2-d_1^2)/(P \cdot d^4))^{0.5} \cdot t^{1.2} \cdot Ft \cdot 1.5$

= 172.7 N/mm^2

・Effective section

A= 11.2 mm^2

σt= 37.1 N/mm^2

$\sigma t/ft$= 0.21 <1.0 OK !

β	0.6
Screw diameter	5
Core diameter	3.78
Pitch	0.8
t(Thickness)	4.6
Ft(Standard strength)	100

16-2 Examination of Beam bending stress

・Beam top face bending moment

M= 2334.0 N・mm

Z= 58.6 mm^3

σb= 39.9 N/mm^2

$\sigma b/fb$= 0.19 <1.0 OK !

b(Beam depth dimension)	61
t(Thickness)	2.4
a(load point)	18.5

17. Examination of rafter and main frame connection

17-1 Examination of screw pull-out force

・Pull-out force/screw

T= 312.1 N

・Stretching permissible stress

$ft= 2.1 \cdot \beta \cdot ((d^2-d_1^2)/(P \cdot d^4))^{0.5} \cdot t^{1.2} \cdot Ft \cdot 1.5$

= 93.7 N/mm^2

・Effective section

A= 6.7 mm^2

σt= 46.3 N/mm^2

$\sigma t/ft$= 0.49 <1.0 OK !

β	0.6
Screw diameter	4
Core diameter	2.93
Pitch	0.7
t(Thickness)	2.1
Ft(Standard strength)	100

17-2 Examination of Main frame bending stress

・Main frame top face bending moment

M= 898.7 N・mm

Z= 22.0 mm^3

σb= 40.8 N/mm^2

$\sigma b/fb$= 0.20 <1.0 OK !

b(Beam depth dimension)	25
t(Thickness)center	2.3
a(load point)	10

18. Examination of Roof material

18-1 Examination of Bending volume

Poisson ratio : ν =	0.3	
Distribution Load : P=	0.0116	kgf/cm^2
E: Young's modulus factor =	21000	kgf/cm^2
Thickness : h=	0.18	cm
Short edge a=	70.3	cm
Long edge b=	296.2	cm

Bending volume : Wmax

$A \cdot Wmax^3 + B \cdot Wmax + C = 0$

$A = (4\nu/a^2b^2 + (3-\nu^2)\cdot(1/a^4+1/b^4))/h^3$

= 2096.9

$B = (4/3)\cdot(1/a^2+1/b^2)^2/h$

= 33.8

$C = -256(1-\nu^2)P/(\pi^6 E h^4)$

= -12701.0

Bending volume : Wmax= 1.82 cm

18-2 Bending stress degree

$\max \sigma x = ((\pi^2 \cdot E \cdot Wmax)/(8\cdot(1-\nu^2)))\cdot((2-\nu^2)Wmax+4h)/a^{2+}(\nu(Wmax+4h))/b2)$

= 44.4 kgf/cm^2 < 551 kgf/cm^2 ∴OK !

18-3 Necessary depth of insert

Necessary depth of insert ΔL

ΔL = ΔX x SF + ΔI

However, ΔX : The gap volume by a bend

= (lx − b)／2

lx : Arc length while bending

= 2 x sin−1[(b／2)／r] x r

r : Radius rate while bending

= (b2+4δ2)／8δ

δ : Bending rate of Polycarbonate = Wmax (cm)

b : Length of short (cm)

ΔI : The volume of expansion and contraction at temperature

= K · Δt · b／2

K : Line coefficient of expansion (cm／cm／℃)

Δt : Temperature differency at 50℃

SF : Safety ratio SF=3. 0

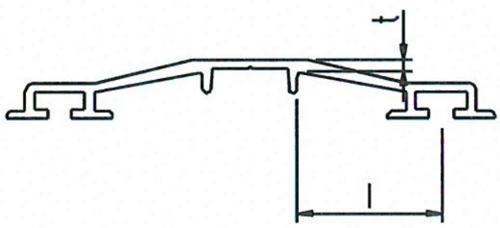
r=	340.4	
lx=	70.43	cm
ΔX=	0.06	cm
K=	0.00007	cm/cm/℃
Δt =	50	℃
SF=	3.0	
ΔI=	0.12	cm

Therefore…

ΔL= 0.31 cm depth or more < 1.89 cm ∴OK !

19. Examination of Roof retainer

Rafter pitch=	715	mm
Supporting length l=	15	mm
Material thickness t=	1.2	mm
F: Standard strength=	132	N/mm^2
Blow up load ω=	383.4	N/m
Load P=ωb=	3.834	N
M=P·l=	5.8	Ncm
Section factor Z=bt^2／6=	0.002	cm^3
σb=M/Z=	24.0	N/mm^2



σb/fb= 0.18 <1.0 OK !

20. Ground Foundation

20-1 Without concrete floor

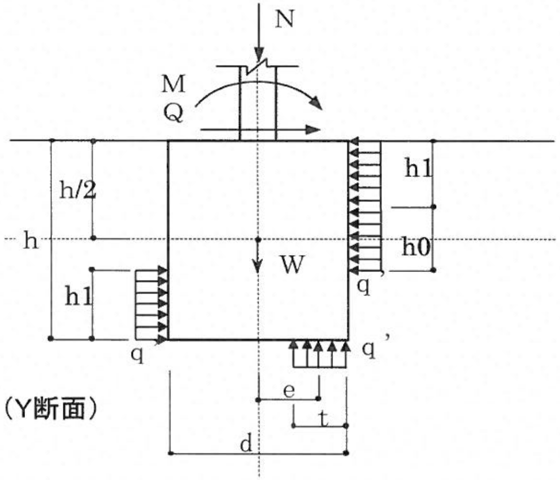
Resistance moment

M_R=(N+W)×e+q's×b×h_1×(h_1+h_0)

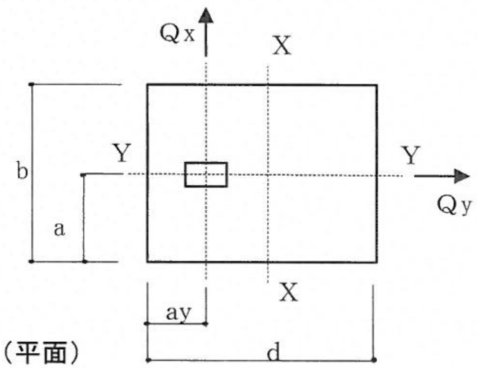
Resistance moment

M=M'+Q*(h/2)−N x (d/2−a)

Base Foundation	
Lateral Pressure	**0.5**
b=	0.90 m
d=	1.20 m
h=	0.55 m
ay=	0.30 m
ax=	0.45 m
Endurance strength of ground Fe=	100 KN/m^2
Short Term Permissible Endurance strength of ground q=	200 KN/m^2
No line concrete Volume weight	22.5 KN/m^3



(Y断面)



(平面)

	Spindle Force(N)	Shear power(N)		Moment(Nm)		Foundation size(m)				Base Weight	Endurance strength of ground	Lateral Pressure
	N	Qx	Qy	M'x	M'y	b	d	h	a	W(N)	q'(kN/m2)	's(kN/m2)=0.5
Long period load	470.8	0.0	0.0	525.4	0.0	0.90	1.20	0.55	0.30	13,365	100	50.0
Short period load	4351.6	0.0	0.0	5779.0	0.0	0.90	1.20	0.55	0.30	13,365	200	100.0
Short term earthquake X	470.8	116.4	0.0	525.4	262.0	0.90	1.20	0.55	0.30	13,365	200	100.0
Short term earthquake Y	470.8	0.0	116.4	787.3	0.0	0.90	1.20	0.55	0.30	13,365	200	100.0
Short period blow down + Holizontal	3217.4	637.4	0.0	4243.5	1434.2	0.90	1.20	0.55	0.30	13,365	200	100.0
Short period blow down + Holizontal	3217.4	0.0	840.6	6134.9	0.0	0.90	1.20	0.55	0.30	13,365	200	100.0
Short period blow up+Holizontal X	−4106.8	637.4	0.0	−5671.6	1434.2	0.90	1.20	0.55	0.30	13,365	200	100.0
Short period blow up+Holizontal Y	−4106.8	0.0	−840.6	−7563.0	0.0	0.90	1.20	0.55	0.30	13,365	200	100.0

■Examination of subsidence (short period snow)

subsidence load		Endurance strength of ground	
N+W (N)	<	b×d×q (N)	
17717		216000	∴OK !

■Examination of uplift (short period blow up)

uplift load		Base weight	
N (N)	<	b×d×h×γ(N)	
4107		13365	∴OK !

	X direction							
	t(m)	e(m)	h0(m)	h1(m)	Resistance MRx	Fall Mx		JUDGMENT
	(N+W)/(b×q')	(d−t)/2	Qy/(b×q's)	(h−h0)/2	MRx(N·m)	Mx(N·m)	Mx/MRx	MR≧M
Long period load	0.154	0.523	0.000	0.275	10,641	384.1	0.036	<1.0 OK !
Short period load	0.098	0.551	0.000	0.275	16,564	4473.5	0.270	<1.0 OK !
Short term earthquake X	0.077	0.562	0.000	0.275	14,576	384.1	0.026	<1.0 OK !
Short term earthquake Y	0.077	0.562	0.001	0.274	14,576	678.1	0.047	<1.0 OK !
Short period blow down + Holizontal X	0.092	0.554	0.000	0.275	15,992	3278.3	0.205	<1.0 OK !
Short period blow down + Holizontal Y	0.092	0.554	0.009	0.270	15,990	5400.8	0.338	<1.0 OK !
Short period blow up+Holizontal X	0.051	0.574	0.000	0.275	12,123	−4439.6	0.366	<1.0 OK !
Short period blow up+Holizontal Y	0.051	0.574	0.009	0.270	12,121	−6562.1	0.541	<1.0 OK !

	Y direction							
	t(m)	e(m)	h0(m)	h1(m)	Resistance MRx	Fall Mx		JUDGMENT
	(N+W)/(d×q')	(b−t)/2	Qx/(d×q's)	(h−h0)/2	MRy(N·m)	My(N·m)	My/Mry	MR≧M
Short term earthquake X	0.058	0.421	0.001	0.275	14,902	294.0	0.020	<1.0 OK !
Short period blow down + Holizontal X	0.069	0.415	0.005	0.272	15,963	1609.5	0.101	<1.0 OK !
Short period blow up+Holizontal X	0.039	0.431	0.005	0.272	13,062	1609.5	0.123	<1.0 OK !

21-1 With concrete floor

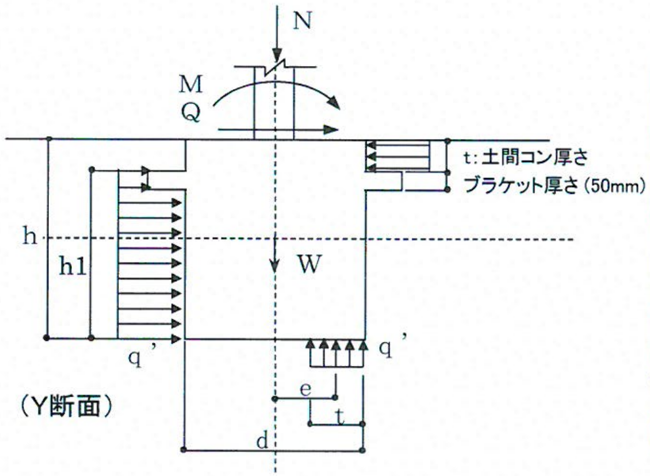
Resistance moment

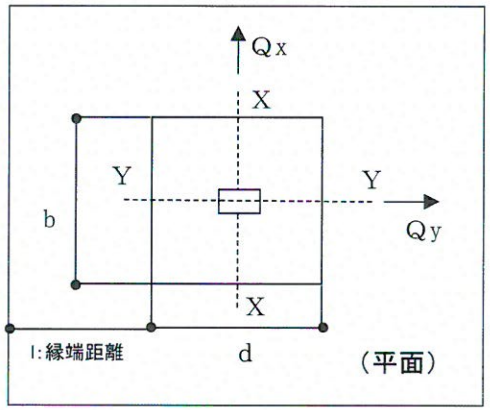
M_R=(N+W)×e+q's×b×h_1×h_1/2

Fall moment

M=M'+Q*(h/2)

	Base Foundation	
	Lateral Pressure	**0.5**
	b=	0.60 m
	d=	0.45 m
	h=	0.55 m
	h_1=	0.45 m
	l=	0.35 m
	Concrete floor thickness t=	0.10 m
	Endurance strength of ground Fe=	50 KN/m^2
	Short Term Permissible Endurance strength of ground q=	100 KN/m^2
	No line concrete Volume weight γ=	22.5 KN/m^3
	Concrete standard strength Fc=	15000 KN/m^3





	Spindle Force(N)	Shear power(N)		Moment(Nm)		Foundation size(m)					Base Weight	Endurance strength of ground	Lateral Pressure
	N	Qx	Qy	M'x	M'y	b	d	h	nd part lengt	oor thicknes	W(N)	q'(kN/m2)	's(kN/m2)=0.5c
Long period load	470.8	0.0	0.0	525.4	0.0	0.60	0.45	0.55	0.35	0.10	3,341	50	25.0
Short period load	4351.6	0.0	0.0	5779.0	0.0	0.60	0.45	0.55	0.35	0.10	3,341	100	50.0
Short term earthquake X	470.8	116.4	0.0	525.4	262.0	0.60	0.45	0.55	0.35	0.10	3,341	100	50.0
Short term earthquake Y	470.8	0.0	116.4	787.3	0.0	0.60	0.45	0.55	0.35	0.10	3,341	100	50.0
Short period blow down + Holizontal X	3217.4	637.4	0.0	4243.5	1434.2	0.60	0.45	0.55	0.35	0.10	3,341	100	50.0
Short period blow down + Holizontal Y	3217.4	0.0	840.6	6134.9	0.0	0.60	0.45	0.55	0.35	0.10	3,341	100	50.0
Short period blow up+Holizontal X	-4106.8	637.4	0.0	-5671.6	1434.2	0.60	0.45	0.55	0.35	0.10	3,341	100	50.0
Short period blow up+Holizontal Y	-4106.8	0.0	-840.6	-7563.0	0.0	0.60	0.45	0.55	0.35	0.10	3,341	100	50.0

■Examination of subsidence (short period snow)

subsidence load		Endurance strength of ground	
N+W (N)	<	b×d×q (N)	
7693		27000	∴OK !

■Concrete floor panchingshere (short term wind blow up)

share force		permissible share force	
Q (N)	<	1.5×fs×t×0.9l×2(N)	
57563		94500	∴OK !

■Concrete floor bearing capacity (short term wind blow up)

share force		bearing capacity	
Q (N)	<	fc×b×0.875t/2(N)	
57563		262500	∴OK !

	X direction						
	Vertical load N+W(N)	t(m) (N+W)/(b×q')	e(m) (d-t)/2	Resistance MRx MRx(N·m)	Fall Mx Mx(N·m)	Mx/MRx	JUDGMENT MR≧M
Long period load	3812.1	0.127	0.161	2,134	131.3	0.062	<1.0 OK !
Short period load	7692.9	0.128	0.161	4,275	1444.7	0.338	<1.0 OK !
Short term earthquake X	3812.1	0.064	0.193	3,774	131.3	0.035	<1.0 OK !
Short term earthquake Y	3812.1	0.064	0.193	3,774	199.7	0.053	<1.0 OK !
Short period blow down + Holizontal X	6558.7	0.109	0.170	4,155	1060.9	0.255	<1.0 OK !
Short period blow down + Holizontal Y	6558.7	0.109	0.170	4,155	1554.7	0.374	<1.0 OK !
Short period blow up+Holizontal X	0.0	0.000	0.225	3,038	-1417.9	0.467	<1.0 OK !
Short period blow up+Holizontal Y	0.0	0.000	0.225	3,038	-1911.8	0.629	<1.0 OK !

	Y direction						
	Vertical load N+W(N)	t(m) (N+W)/(b×q')	e(m) (d-t)/2	Resistance MRx MRx(N·m)	Fall Mx Mx(N·m)	Mx/MRx	JUDGMENT MR≧M
Short term earthquake X	3812.1	0.085	0.258	3,260	68.4	0.021	<1.0 OK !
Short period blow down + Holizontal X	6558.7	0.146	0.227	3,768	374.5	0.099	<1.0 OK !
Short period blow up+Holizontal X	0.0	0.000	0.300	2,278	374.5	0.164	<1.0 OK !

STATIC REPORT

PJR－series

4333-H23

2016. 01. 26

SankyoTateyama,Inc.

1. Material and Evaluation

①Post

Materi. A6063S-T6(SS)

Colum

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N/mm2
DE8387	12.15	475.04	161.02	63.34	33.90	70000	3.64	180

Material evaluation (without support and side panel Vex=38m/s)

Snow for short period

$\sigma b/fb+\sigma c/fc=$ 0.62 <1.0 OK !

Wind blow down

$\sigma b/fb+\sigma c/fc=$ 0.61 <1.0 OK !

Wind blow up

$\sigma b/fb+\sigma t/ft=$ 0.69 <1.0 OK !

2・lk/i= 112.0 <140 OK !

②Beam

Materi. A6063S-T6(SS)

Beam

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N/mm2
DE8392	7.75	187.39	53.85	30.22	16.07	70000	2.64	180

Material evaluation (without support and side panel Vex=38m/s)

Snow for short period

$\sigma b/fb=$ 0.77 <1.0 OK !

Wind blow down

$\sigma bx/fbx=$ 0.57 <1.0 OK !

Wind blow up

$\sigma bx/fbx=$ 0.76 <1.0 OK !

③Main frame

Materi. A6063S-T6(SS)

Purlin

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N/mm2
DE8578有	1.64	5.33	2.07	2.27	0.91	70000	1.13	180

Material evaluation

$\sigma b/fb=$ 0.39 <1.0 OK !

④Front frame

Materi. A6063S-T5

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N/mm2
DE8401	2.55	12.50	6.91	3.81	2.20	70000	1.65	132

Material evaluation

$\sigma b/fb=$ 0.18 <1.0 OK !

⑤Rear frame

Materi. A6063S-T5

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N/mm2
DE8404有	2.55	7.70	5.90	2.34	1.82	70000	1.52	132

Material evaluation

$\sigma b/fb=$ 0.25 <1.0 OK !

⑥**Rafter**

Materi. A6063S-T5

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N/mm2
DE8654+DE8666	1.88	0.36	3.75	0.53	1.48	70000	1.41	132

Material evaluation

$\sigma b/fb=$ 0.57 ＜1.0 OK !

⑦**Side frame**

Materi. A6063S-T5

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N/mm2
DE8683+DE8412	1.65	0.40	2.00	0.32	0.93	70000	1.10	132

Material evaluation

$\sigma b/fb=$ 0.40 ＜1.0 OK !

⑧**Corner bracket**

Materi. SPFH590

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N/mm2
GB8064	8.58	205.21	65.07	28.12	20.34	210000	2.75	420

Material evaluation (without support and side panel Vex=38m/s)

$\sigma bx/fb=$ 0.44 ＜1.0 OK !

$\sigma by/fb=$ 0.10 ＜1.0 OK !

⑨**Main frame connecting parts**

Materi. A6063S-T5

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N/mm2
GB8086	2.77	5.59	1.85	2.87	1.69	70000	0.82	132

Material evaluation

$\tau /fs=$ 0.01 ＜1.0 OK !

⑩**Front frame connecting parts**

Materi. A6063S-T5

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N/mm2
GB8084	2.62	6.94	4.75	2.95	2.26	70000	1.35	132

Material evaluation

$\tau /fs=$ 0.01 ＜1.0 OK !

⑪**Rear frame connecting parts**

Materi. A6063S-T5

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N/mm2
GB8085	1.92	2.92	1.83	1.78	1.40	70000	0.98	132

Material evaluation

$\tau /fs=$ 0.01 ＜1.0 OK !

⑫Roof material

Materi: polycarbonate

Material performance

Material	Thickness	Length(short part)	Length(long part)	Inserting	Poisson ratio	Elasticity factor	F value
	cm	cm	cm	cm	ν	kgf/cm2	kgf/cm2
GB4107	0.18	70.3	326.4	1.89	0.3	21000	551

Material evaluation

Bending volume : Wmax= 1.82 cm

max σ x= 44.50 kgf/cm^2 < 551.0 kgf/cm^2 ∴OK !

Necessary depth of insert ΔL 0.31 cm depth or more < 1.89 cm ∴OK !

⑬Roof retainer

Materi: A6063S-T5

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N/mm2
DE8411	0.79	0.03	1.84	0.08	0.72	70000	1.52	132

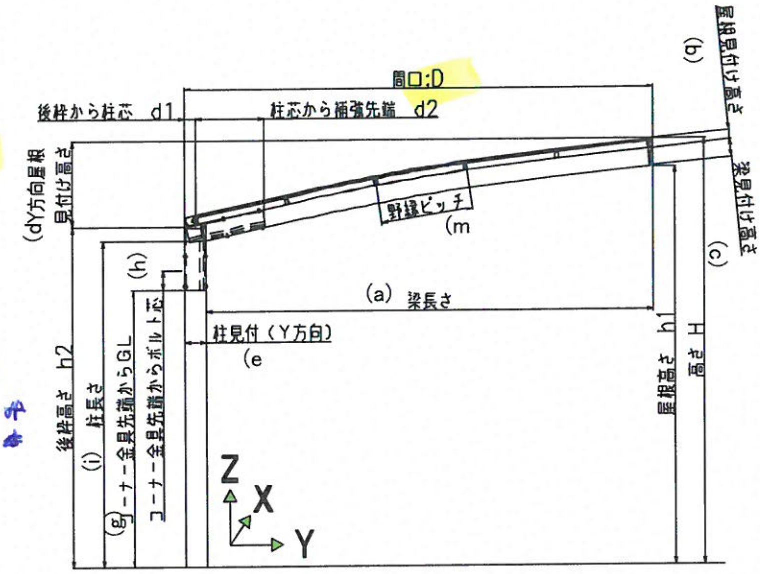
Material evaluation

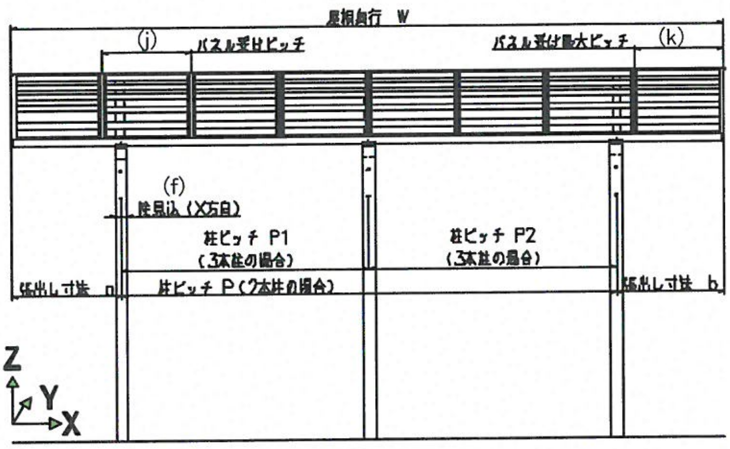
σ b/fb= 0.18 <1.0 OK !

2. Carport detail

type 4333-H23

Roof projection A=	14.23 m^2
Burden projection per post=	4.74 m^2
Depth : D=	3.300 m
Roof length : W=	4.312 m
from rear frame to post core d1=	0.075 m
from post core to reinforcing end d2=	0.484 m
(a)Beam length=	3.150 m
Overhang length a=	0.856 m
post pitch : P1=	1.300 m
post pitch : P2=	1.300 m
Overhang length b=	0.856 m
(b) Roof part thickness	0.065 m
(c) Beam thickness	0.124 m
(d) Y direction roof part height=	0.588 m
(e) Post dimension(Y direction)=	0.150 m
(f) Post dimension(X direction)=	0.095 m
Overall Height(GL to Roof end) H=	2.936 m
Overall Height(GL to Beam) h1=	2.746 m
Overall Height(GL to Rear frame) h2=	2.348 m
(g) from the end of corner bracket to GL=	1.910 m
(h) from the end of corner bracket to the center of bolts=	0.130 m
(i) Post length=	2.250 m
Post quantity=	3
(j) Rafter pitch=	0.715 m
(k) Rafter maximum span=	0.726 m
(m) Main frame pitch=	0.645 m





1.506 × ~~1.58~~ 0.551 = ~~2.38~~ 0.829 kN/m

0.829

$\frac{\text{~~2.57~~} \times 3.3^2}{2}$ = ~~12.95~~ 4.51 kN.m

4.23 kN.m

3. Load design

①Vertical over load (G)

Part Weight

Part	Weight
Roof	60.0 N/m^2
Post	32.1 N/m

②Snow over load

Post quantity	Snow area	Snow quantity	Unit weight	Short period snow period
2 posts type	General area	20 cm	30 $N/m^2/cm$	600 N/m^2

③ Wind blowing load(Vex=38m/s)

・For design of structure frame

Speed pressure $q=0.6E(Vex \cdot y)^2=$ 708 N/m^2

Standard wind speed $Vex=$ 38 m/s

$E=Er^2Gf=$ 1.194

$Er=1.7(Zb/Z_G)^{\alpha}=$ 0.691

Ground surface Div. Ⅲ

Gust influence factor $Gf=$ 2.5

$Zb=$ 5

$Z_G=$ 450

$\alpha=$ 0.2

Installation period factor $y=$ 0.827

・For roof material design

Average speed pressure $q'=0.6Er2(Vex \cdot y)^2=$ 283 N/m^2

④Earthquake power

Earthquake power $Qi=Z \cdot Rt \cdot Ai \cdot Co \cdot Wi$

Area factor $Z=$ 1.0

Vibration feature $Rt=$ 1.0

Coat shear power distribution factor $Ai=$ 1.0

Standard shear power factor $C_o=$ 0.3

4. Preparing calculation

4−1　Carport load (For earthquake power calculation)

Roof	285	N
Post	72	N
Wi=	357	N

Earthquake power Qi=Z·Rt·Ai·Co·Wi=　107.1 N

4−2　Wind pressure power calculation (Maximum wind power pressure for 1 post)

·For design of structure frame

Wind factor		
Independent shed	10 °	
C=	0.60	(+pressure)
	−1.00	(−pressure)
	1.2	(Post flat power, side panel)

Wind pressureW=q C=	425 N/m^2	(Wind blow down)
	−708 N/m^2	(Wind blow up)
	849 N/m^2	(Flat)

·Roof material design

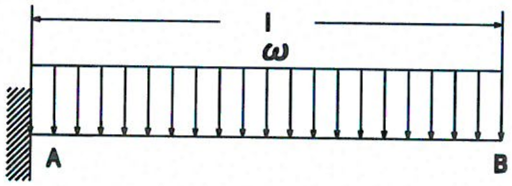
Peak with factor calculation process Gpe=	3.1	(+pressure)
	3.0	(−pressure: panel center part)
	4.0	(−pressure: panel surrounding part)

Peak wind factor Cf=	3.1	x	0.60	=	1.86
	3.0	x	−1.00	=	−3.00
	4.0	x	−1.00	=	−4.00

Wind pressure W=q' Cf=	527 N/m^2	(Wind blow down)
	−849 N/m^2	(Wind blow up)
	−1132 N/m^2	(Wind blow up)

5. Beam material examination

5-1 Beam load (without support Vex=38m/s)



Load chart

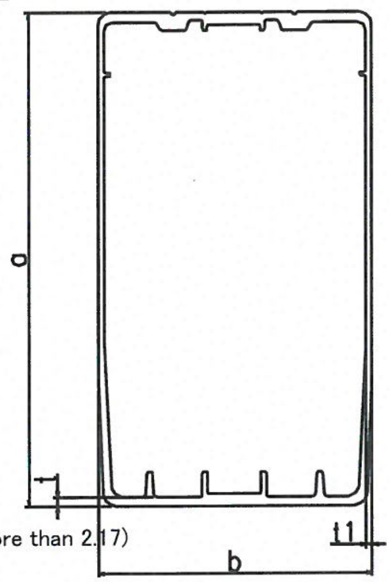
Type			
Vertical load width (m)			1.506
l (m)	D-d1-d2		2.741
Load ω (N/m)	Long period load		90.4
	Short period load		994.0
	Short period blowing down(vertical)		729.9
	Short period blowing up(vertical)		-975.5
	Short period blowing down(horizontal)		133.8
	Short period earthquake(vertical)		90.4
	Short period earthquake(horizontal)		27.1
Bending moment M(N・m)	Long period load		339.4
	Short period load		3733.9
	Short period blowing down(vertical)		2741.8
	Short period blowing up(vertical)		-3664.5
	Short period blowing (horizontal)		502.5
	Short period earthquake(vertical)		339.4
	Short period earthquake(horizontal)		101.8
Maximum bending mom (N・m)	maxMx	(long period)	
		(short period)	3733.9
	maxMy	(long period)	
		(short period)	502.5
Second section mome	Ix(cm^4)		187.4
	Iy(cm^4)		53.8
Section factor	Zx(cm^3)		30.2
	Zy(cm^3)		16.1
Elasticity factor	E(N/cm^2)		7000000
Maximum bending stre (N/mm2)	max σx		123.6
	max σy		31.3
Vertical maximum defo	max δx	(cm)	5.35
	max δx/l	1/	81
Flat maximum deforma	max δy	(cm)	2.50
	max δy/l	1/	172

5-2 Beam permissible stress degree

Bending permissible stress degree

	Permissible stress degree for long period (N/mm2)	Permissible stress for short period(N/m3)
$b\lambda \leqq b\lambda p$	F/ν	Long period x 1.5
$b\lambda p < b\lambda \leqq b\lambda e$	$(1.0-0.5((b\lambda - b\lambda p)/(b\lambda e - b\lambda p)))F/\nu$	Long period x 1.5
$b\lambda e < b\lambda$	$(1/b\lambda^2)\cdot(F/\nu)$	Long period x 1.5

a=	12.40	cm
t=	0.22	cm
t1=	0.15	cm
b=	6.70	cm
Young's modulus factor E=	70000	N/mm^2
Shear elasticity factor of bending materialG=	27000	Nmm
Torsion fixed number of bending material=	114.7	cm^4
Second section moment around weak axis Iy=	53.847	cm^4
Section factor of bending direction Z=	30.22	cm^3
F:Standard strength(N/mm2)=	180	N/mm^2
$b\lambda=\sqrt{(My/Me)}$=	0.14	
$Me=C\sqrt{((\pi^2 EIyGJ)/lb^2)}$=	291184326	Nmm
Bending moment My=	5439600	Nmm
$C=1.75+1.05(M2/M1)+0.3(M2/M1)^2$=	1.75	
M2=	0	Nm
M1=	3664	Nm
M2/M1=	0	
lb=	645.1	mm
$b\lambda p=0.6+0.3(M2/M1)$=	0.6	
$b\lambda e=1/\sqrt{0.5}$=	1.41	



$\nu=3/2+2(b\lambda/b\lambda e)^2/3$ (its value assumes 2.17 in case more than 2.17)

ν = 1.51

$b\lambda \leqq b\lambda p$

Permissible stress degree fb: F/ν = 119.5 N/mm^2

Permissible stress degree at bend parts (strong axis)

1) Frange plate of beam <top/bottom face>

Γb : The conversion ratio = $b/t \cdot \sqrt{(F/E)}$

Γb = 1.48

a) Γb ≦ 1.34 fb = F/1.5

b) 1.34 < Γb ≦ 2.69 fb = F − 0.248FΓb

c) 2.69 < Γb fb = 2.41 F/(Γb^2)

fb= 114.1 N/mm^2

2) Web plate of beam <side face>

Γd : The conversion ratio = $d/t \cdot \sqrt{(F/E)}$

Γd = 4.04

a) Γd ≦ 3.29 fb = F/1.5

b) 3.29 < Γd ≦ 6.57 fb = F − 0.101FΓ

c) 6.57 < Γd fb = 14.4 F/(Γd^2)

fb= 106.5 N/mm^2

Therefore, result data is…

fbx= 106.5 N/mm^2

fbx= 159.7 N/mm^2

Permissible stress degree at bend parts (weak axis)

1) Frange plate of beam <top/bottom face>

Γb : = b/t・√(F/E)

	Γb =	4.04
a) $\Gamma b \leqq 1.34$	fb = F/1.5	
b) $1.34 < \Gamma b \leqq 2.69$	fb = F − 0.248FΓb	
c) $2.69 < \Gamma b$	fb = 2.41 F/(Γb^2)	
	fb=	26.5 N/mm^2

2) Web plate of beam <side face>

Γd :The conversion ratio = d/t・√(F/E)

	Γd =	1.48
a) $\Gamma d \leqq 3.29$	fb = F/1.5	
b) $3.29 < \Gamma d \leqq 6.57$	fb = F − 0.101FΓ	
c) $6.57 < \Gamma d$	fb = 14.4 F/(Γd^2)	
	fb=	120.0 N/mm^2

Therefore, result data is…

fby=	26.5 N/mm^2
fby=	**39.8 N/mm^2**

Section of the Beam examination

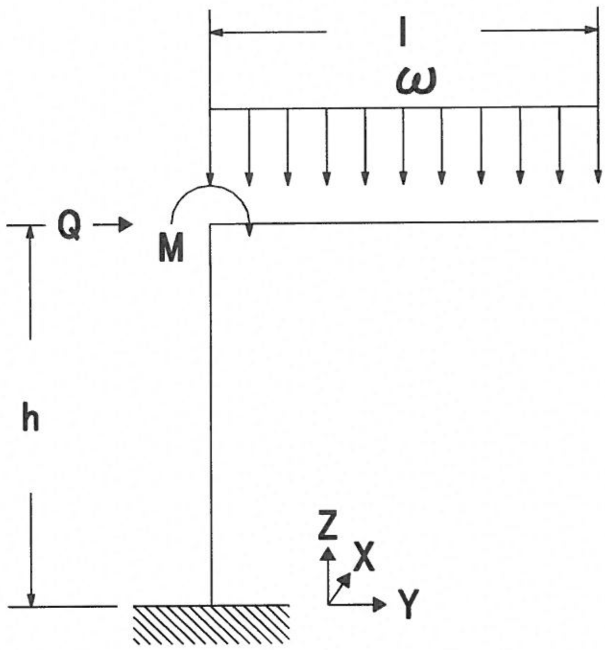
Snow for short period			
M=	3733.9 N・m		
σb=	123.6 N/mm^2		
$\sigma b/fb$=	0.77	<1.0	OK !
Wind blow down			
M=	2741.8 N・m		
σbx=	90.7 N/mm^2		
$\sigma bx/fbx$=	0.57	<1.0	OK !
Wind blow up			
M=	-3664.5 N・m		
σbx=	121.3 N/mm^2		
$\sigma bx/fbx$=	0.76	<1.0	OK !
Wind blow horizontal			
M=	502.5		
σby=	31.3		
$\sigma by/fby$=	0.79	<1.0	OK !

6. Post material examination

6-1 Post load

Load chart

Type		
Vertical load width (m)		1.506
l (m)	D-d1	3.150
Load ω(N/m)	Long period load	90.4
	Short period snow load	994.0
	Short period blowing down(vertical	729.9
	Short period blowing up(vertical)	-975.5
	Short period earthquake(vertical)	90.4
Axial force by vertical load N(N)	Long period load	370.5
	Short period snow load	3352.4
	Short period blowing down(vertical	2480.9
	Short period blowing up(vertical)	-3146.8
	Short period earthquake(vertical)	370.5
Flat load Q(N)	Short period wind X	677.5
	Short period wind Y	626.2
	Short period earthquakeX、Y	85.4
Bending moment M(N·m)	Long period load	448.3
	Short period snow load	4931.3
	Short period blowing down(vertical	3621.1
	Short period blowing up(vertical)	-4839.6
	Short period earthquake(vertical)	448.3
Bending moment by vertical and flat load Mx(N·m)	Short period blowing down(vertical)+WindY	5030.0
	Short period blowing up(vertical)+WindY	-6248.6
	Short period earthquake(vertical) + Earthquak	640.4
Bending moment by flat load My(N·m)	Short period windX	1524.5
	Short period earthquakeX	192.1
Maximum bending moment(N·m)	maxMx (long period)	
	(short period)	6248.6
	maxMy (short period wind)	1524.5
	(short period earthqual	192.1
Second section moment	Ix(cm^4)	475.041
	Iy(cm^4)	161.02
Section factor	Zx(cm^3)	63.339
	Zy(cm^3)	33.90
Max. bending stress deg. σx(N/mm2)	Long period load	7.08
	Short period snow load	77.86
	Short period blowing down(vertical	57.17
	Short period blowing up(vertical)	-76.41
	Short period earthquake(vertical)	7.08
	Short period blowing up(vertical)+WindY	79.41
	Short period blowing down(vertical)+WindY	-98.65
	Short period earthquake(vertical) + Earthquak	10.11
max σx(N/mm2) (uniaxial bending)	Long period	7.08
	Short period(Y direction Vertical load)	98.65
Bending stress degree σy(N/mm2)	Short period windX	44.97
	Short period earthquakeX	5.67



6-2 Post permissible stress degree

Permissible pressure stress degree

	Permissible stress degree for long period (N／mm2)	For short period(N/m3)
$c\lambda \leqq c\lambda p$	F/ν	Long period x 1.5
$c\lambda p < c\lambda \leqq c\lambda e$	$(1.0-0.5((c\lambda - c\lambda p)/(c\lambda e - c\lambda p)))F/\nu$	Long period x 1.5
$c\lambda e < c\lambda$	$(1/c\lambda^2)\cdot(F/\nu)$	Long period x 1.5

a= 15.00 cm
t= 0.34 cm
t1= 0.16 cm
b= 9.50 cm

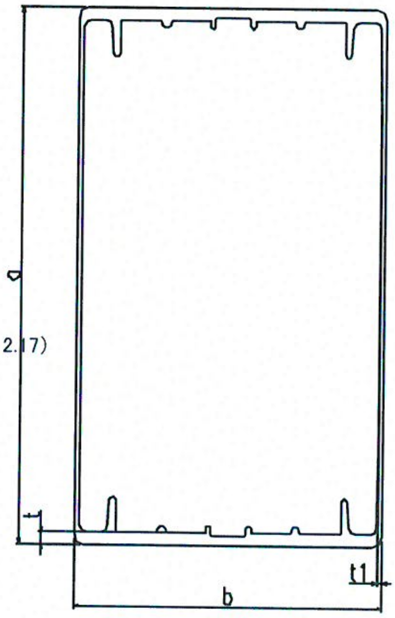
$c\lambda = (lk/i)\sqrt{(F/\pi^2 E)}$ = 1.8

lk : Buckling length (cm) = 407.96 cm
Standard strength F (N／mm2) = 180 N/mm^2
E : Young's modulus factor (N／mm2) = 70000 N/mm^2

$c\lambda p$= 0.2

$c\lambda e = 1/\sqrt{0.5}$= 1.41

$\nu = 3/2 + 2(c\lambda / c\lambda e)2/3$ (its value assumes 2.17 in case more than 2.17)
ν = 2.17
H= 203.98 cm
Section second radius i (cm) = 3.64 cm



$c\lambda e < c\lambda$
fc= 38.9 N/mm^2

Permissible stress degree at bend parts

1) Frange plate of beam <top/bottom face>

$\Gamma b \ := b/t \cdot \sqrt{(F/E)}$

Γb = 1.37

a) $\Gamma b \leqq 1.34$ fb = F/1.5
b) $1.34 < \Gamma b \leqq 2.69$ fb = F − 0.248FΓb
c) $2.69 < \Gamma b$ fb = 2.41 F/(Γb^2)

fc= 118.9 N/mm^2

2) Web plate of beam <side face>

$\Gamma d \ := d/t \cdot \sqrt{(F/E)}$

Γd = 4.54

a) $\Gamma d \leqq 1.34$ fb = F/1.5
b) $1.34 < \Gamma d \leqq 2.69$ fb = F − 0.248FΓd
c) $2.69 < \Gamma d$ fb = 2.41 F/(Γd^2)

fc= 21.1 N/mm^2

Therefore, result date is・・・

fc= 21.1 N/mm^2

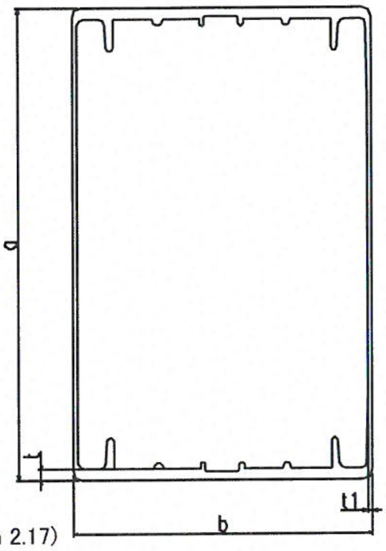
fc= 31.6 N/mm^2

6-3 Permissible stress degree at bend parts

Permissible bending stress degree

	Permissible stress degree for long period (N／mm2)	For short period(N/m3)
$b\lambda \leqq b\lambda p$	F/ν	Long period x 1.5
$b\lambda p < b\lambda \leqq b\lambda e$	$(1.0-0.5((b\lambda - b\lambda p)/(b\lambda e - b\lambda p)))F/\nu$	Long period x 1.5
$b\lambda e < b\lambda$	$(1/b\lambda^2)\cdot(F/\nu)$	Long period x 1.5

a=	15.00	cm
t=	0.34	cm
t1=	0.16	cm
b=	9.50	cm
Young's modulus factor E=	70000	N/mm^2
Shear elasticity factor of bending material G=	27000	Nmm
Torsion fixed number of bending material=	314.8	cm^4
Second section moment around weak axis Iy=	161.022	cm^4
Section factor of bending direction Z=	63.339	cm^3
F: Standard strength (N／mm2) =	180	N/mm^2
$b\lambda = \sqrt{(My/Me)}$=	0.27	
$Me = C\sqrt{((\pi^2 EIyGJ)/lb^2)}$=	161021364	Nmm
Bending moment My=	11401020	Nmm
$C = 1.75 + 1.05(M2/M1) + 0.3(M2/M1)^2$=	1	
M2=	-4839.6	Nm
M1=	4839.6	Nm
M2/M1=	-1	
lb=	1909.8	mm
$b\lambda p = 0.6 + 0.3(M2/M1)$=	0.3	
$b\lambda e = 1/\sqrt{0.5}$=	1.41	



$\nu = 3/2 + 2(b\lambda / b\lambda e)^2/3$ (its value assumes 2.17 in case more than 2.17)

ν = 1.52

$b\lambda \leqq b\lambda p$

Permissble stress degree fb: F/ν = 118.1 N/mm^2

Permissible bending stress degree (strong axis)

1) Frange plate <top/bottom face>

Γb : The conversion ratio = $b/t \cdot \sqrt{(F/E)}$

Γb = 1.37

a) Γb ≦ 1.34 — fc = F/1.5

b) 1.34 < Γb ≦ 2.69 — fc = F − 0.248FΓb

c) 2.69 < Γb — fc = 2.41 F/(Γb2)

fb= 118.9 N/mm^2

2) Web plate <side face>

Γd : The conversion ratio = $d/t \cdot \sqrt{(F/E)}$

Γd = 4.54

a) Γd ≦ 3.29 — fb = F/1.5

b) 3.29 < Γd ≦ 6.57 — fb = F − 0.101FΓd

c) 6.57 < Γd — fb = 14.4 F/(Γd^2)

fb= 97.5 N/mm^2

Therefore, result date is・・・

fbx= 97.5 N/mm^2

fbx= **146.2** N/mm^2

Permissible bending stress degree (weak axis)

1) Frange plate <top/bottom face>

Γb : The conversion ratio = b/t・√(F/E)

	Γb=	4.54
a) Γb ≦ 1.34	fc =	F/1.5
b) 1.34 < Γb ≦ 2.6 9	fc =	F − 0.248FΓd
c) 2.69 < Γb	fc =	2.41 F/(Γd2)
	fb=	21.1 N/mm^2

2) Web plate <side face>

Γd : The conversion ratio = d/t・√(F/E)

	Γd=	1.37
a) Γd ≦ 3.29	fb =	F/1.5
b) 3.29 < Γd ≦ 6.57	fb =	F − 0.101FΓd
c) 6.57 < Γd	fb =	14.4 F/($Γd^2$)
	fb=	120.0 N/mm^2

Therefore, result date is・・・

fby=	21.1 N/mm^2
fby=	**31.6 N/mm^2**

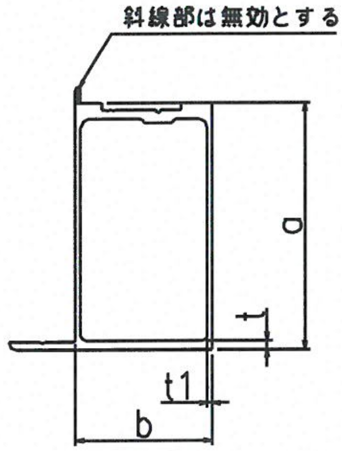
Examination of the section of the post

Short period snow load		
σb=	77.9 N/mm^2	
σc=N/A=	2.8 N/mm^2	
σb/fb+σc/fc=	0.62 <1.0	OK !
Wind blow down		
σb=	79.4 N/mm^2	
σc=N/A=	2.0 N/mm^2	
σb/fb+σc/fc=	0.61 <1.0	OK !
Wind blow up		
σb=	98.7 N/mm^2	
σt=N/A=	2.6 N/mm^2	
σb/fb+σt/ft=	0.69 <1.0	OK !
2・lk/i=	112.0 <140	OK !

7. Main Frame Bending permissible stress degree

7-1 Bending permissible stress degree

	Permissible stress degree for long period (N／mm2)	Permissible stress for short period(N/m3)
$b\lambda \leqq b\lambda p$	F/ν	Long period x 1.5
$b\lambda p < b\lambda \leqq b\lambda e$	$(1.0-0.5((b\lambda - b\lambda p)/(b\lambda e - b\lambda p)))F/\nu$	Long period x 1.5
$b\lambda e < b\lambda$	$(1/b\lambda^2)\cdot(F/\nu)$	Long period x 1.5



a=	4.60	cm
t=	0.10	cm
t1=	0.09	cm
b=	2.50	cm
Young's modulus factor E=	70000	N/mm^2
Shear elasticity factor of bending materialG＝	27000	Nmm
Torsion fixed number of bending material＝	3.2	cm^4
Second section moment around weak axis Iy=	2.072	cm^4
Section factor of bending direction Z=	2.274	cm^3
F:Standard strength(N／mm2)＝	180	N/mm^2
$b\lambda=\sqrt{(My/Me)}$=	0.27	
$Me=C\sqrt{((\pi 2EIyGJ)/lb2)}$=	5535840	Nmm
Bending moment My=	409320	Nmm
C=	1.13	
lb=	715	mm
$b\lambda p=0.6+0.3(M2/M1)$=	0.3	
$b\lambda e=1/\sqrt{0.5}$=	1.41	

$\nu=3/2+2(b\lambda/b\lambda e)^2/3$ (its value assumes 2.17 in case more than 2.17)

ν＝ 1.52

$b\lambda \leqq b\lambda p$

fb= 118.1 N/mm^2

Permissible stress degree at bend parts

1）Frange plate of beam <top/bottom face>

Γb ：The conversion ratio ＝ $b/t\cdot\sqrt{(F/E)}$

Γb＝ 0.41

a）Γb ≦ 0.438 — fb ＝ F/1.5

b）0.438 ＜ Γb ≦ 0.876 — fb ＝ F － 0.760FΓb

c）0.876 ＜ Γb — fb ＝ $0.256\ F/(\Gamma b^2)$

fb= 120.0 N/mm^2

Γb ：The conversion ratio ＝ $b/t\cdot\sqrt{(F/E)}$

Γb＝ 1.18

a) Γb ≦ 1.34 — fc ＝ F/1.5

b) 1.34 ＜ Γb ≦ 2.69 — fc ＝ F － 0.248FΓd

c) 2.69 ＜ Γb — fc ＝ 2.41 F/(Γd2)

fb= 120.0 N/mm^2

2）Wave plate of beam <side face>

Γb ：The conversion ratio ＝ $b/t\cdot\sqrt{(F/E)}$

Γd＝ 2.48

a）Γd ≦ 3.29 — fb ＝ F/1.5

b）3.29 ＜ Γd ≦ 6.57 — fb ＝ F － 0.101FΓ

c）6.57 ＜ Γd — fb ＝ $14.4\ F/(\Gamma d^2)$

fb= 120.0 N/mm^2

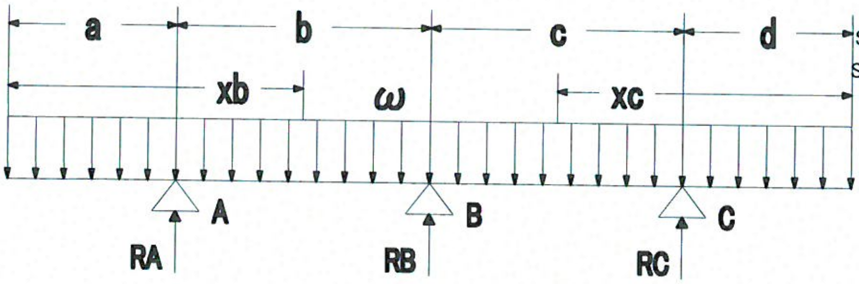
Therefore, result data is…

fb= 118.1 N/mm^2

fb= 177.1 N/mm^2

7-2 Calculation of Main Frame Section

Parts Width= 0.645 m



Long period snow ω=	38.7 N/m
Short period snow load ω=	425.8 N/m
Short period blow down ω=	312.6 N/m
Short period blow up ω=	417.9 N/m
ω=	425.8 N/m
a=	0.856 m
b=	1.3 m
c=	1.3 m
d=	0.856 m
xb=	1.078 m
xc=	1.078 m
Z=	2.274 cm^3
I=	5.325 cm^4
E=	7000000 N/cm^2

W=Full-Load M=Bend Moment
R=Anti-Power θ=Rotation Angle
Q=Shear Power δ=Bend

W= w(a+b+c+d) = 1835.9 N

RA= $w(6a^2b+4a^2c+8ab^2+8abc+3b^3+4b^2c-c^3+2cd^2)/8b(b+c)$ = 752.0 N
RB= $w(4b^2c+4bc^2-4bd^2-2a^2b-2cd^2+c^3-4a^2c+b^3)/8bc$ = 331.9 N
RC= $w(6cd^2+4bd^2++8c^2d+8bcd+3c^3+4bc^2-b^3+2a^2b)/8c(b+c)$ = 752.0 N

MA= $-(wa^2/2)$ = -156.0 N・m
σA= MA/Z = 68.6 N/mm^2

MB= $w\{b(2a^2-b^2)+c(2d^2-c^2)\}/8(b+c)$ = -11.9 N・m
σB= MB/Z = 5.3 N/mm^2

MC= $-(wd^2/2)$ = -156.0 N・m
σC= MC/Z = 68.6 N/mm^2

MXb= $-wx^2/2+RA(x-a)$ = -80.4 (b material)
σXb= MX/Z = -35.4 N/mm^2

MXc= $-wx^2/2+RC(x-d)$ = -80.4 (c material)
σXc= MX/Z = 35.4 N/mm^2

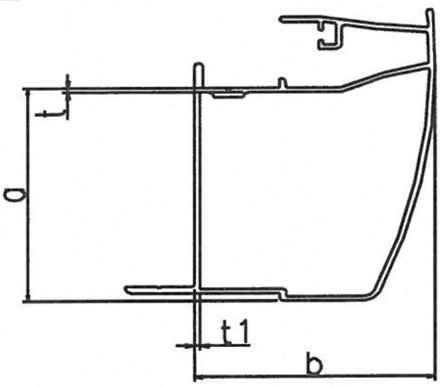
σb/fb = 0.39 <1.0 OK !

8. Front frame bending permissible stress degree

8-1 Bending permissible stress degree

	Permissible stress degree for long period (N／mm2)	Permissible stress for short period(N/m3)
$b\lambda \leqq b\lambda p$	F/ν	Long period x 1.5
$b\lambda p < b\lambda \leqq b\lambda e$	$(1.0-0.5((b\lambda - b\lambda p)/(b\lambda e - b\lambda p)))F/\nu$	Long period x 1.5
$b\lambda e < b\lambda$	$(1/b\lambda^2)\cdot(F/\nu)$	Long period x 1.5

a=	4.77	cm
t=	0.10	cm
t1=	0.10	cm
b=	4.20	cm
Young's modulus factor E=	70000	N/mm^2
Shear elasticity factor of bending materialG＝	27000	Nmm
Torsion fixed number of bending material＝	8.4	cm^4
Second section moment around weak axis Iy=	6.911	cm^4
Section factor of bending direction Z=	3.805	cm^3
F:Standard strength(N／mm2)＝	132	N/mm^2
$b\lambda=\sqrt{(My/Me)}$=	0.17	
$Me=C\sqrt{((\pi 2EIyGJ)/lb2)}$=	16407392	Nmm
Bending moment My=	502260	Nmm
C=	1.13	
lb=	715	mm
$b\lambda p=0.6+0.3(M2/M1)$=	0.3	
$b\lambda e=1/\sqrt{0.5}$=	1.41	



$\nu=3/2+2(b\lambda/b\lambda e)^2/3$ (its value assumes 2.17 in case more than 2.17)

ν= 1.51

$b\lambda \leqq b\lambda p$

fb= 87.4 N/mm^2

Permissible stress degree at bend parts

1) Frange plate of beam <top/bottom face>

Γb : The conversion ratio ＝ $b/t \cdot \sqrt{(F/E)}$

Γb = 1.74

a) Γb ≦ 1.34 fc ＝ F/1.5

b) 1.34 ＜ Γb ≦ 2.69 fc ＝ F － 0.248FΓd

c) 2.69 ＜ Γb fc ＝ 2.41 F/(Γd2)

fb= 75.1 N/mm^2

2) Web plate of beam <side face>

Γd ＝ $d/t \cdot \sqrt{(F/E)}$

Γd = 1.98

a) Γd ≦ 3.29 fb ＝ F/1.5

b) 3.29 ＜ Γd ≦ 6.57 fb ＝ F － 0.101FΓ

c) 6.57 ＜ Γd fb ＝ 14.4 F/(Γd^2)

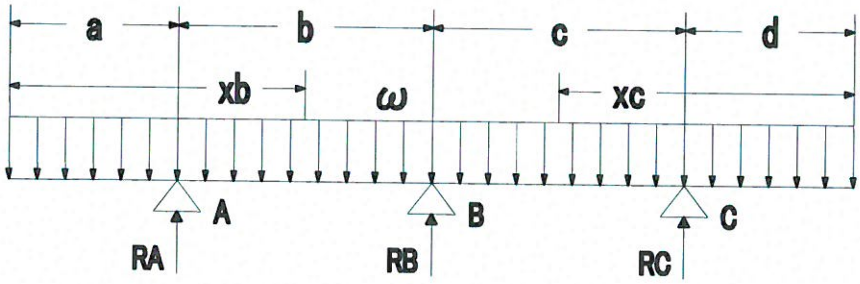
fb= 88.0 N/mm^2

Therefore, result data is…

fb= 75.1 N/mm^2

fb= 112.7 N/mm^2

8-2 Calculation of Front Frame Section



Parts Width=	0.323	m
Long period snow ω=	19.4	N/m
Short period snow load ω=	212.9	N/m
Short period blow down ω=	156.3	N/m
Short period blow up ω=	208.9	N/m
ω=	212.9	N/m
a=	0.856	m
b=	1.3	m
c=	1.3	m
d=	0.856	m
xb=	1.078	m
xc=	1.078	m
Z=	3.805	cm^3
I=	12.495	cm^4
E=	7000000	N/cm^2

W=Full-Load　M=Bend Moment
R=Anti-Power　θ=Rotation Angle
Q=Shear Power　δ=Bend

$W= w(a+b+c+d)$	=	918.0 N
$RA= w(6a^2b+4a^2c+8ab^2+8abc+3b^3+4b^2c-c^3+2cd^2)/8b(b+c)$	=	376.0 N
$RB= w(4b^2c+4bc^2-4bd^2-2a^2b-2cd^2+c^3-4a^2c+b^3)/8bc$	=	165.9 N
$RC= w(6cd^2+4bd^2++8c^2d+8bcd+3c^3+4bc^2-b^3+2a^2b)/8c(b+c)$	=	376.0 N
$MA= -(wa^2/2)$	=	-78.0 N・m
$\sigma A= MA/Z$	=	20.5 N/mm^2
$MB= w[b(2a^2-b^2)+c(2d^2-c^2)]/8(b+c)$	=	-6.0 N・m
$\sigma B= MB/Z$	=	1.6 N/mm^2
$MC= -(wd^2/2)$	=	-78.0 N・m
$\sigma C= MC/Z$	=	20.5 N/mm^2
$MXb= -wx^2/2+RA(x-a)$	=	-40.2 (b material)
$\sigma Xb= MX/Z$	=	-10.6 N/mm^2
$MXc= -wx^2/2+RC(x-d)$	=	-40.2 (c material)
$\sigma Xc= MX/Z$	=	10.6 N/mm^2
$\sigma b/fb$	=	0.18 $<$1.0　OK !

9. **Bending permissible stress degree at rear frame**

9-1 Calculation method of effective section

$\Gamma b = b/t \cdot \sqrt{(F/E)} = 0.438$ Therefore…

$b/t = 0.438/\sqrt{(F/E)} = 10.09$

Effective Depth

t2= 1.70 mm

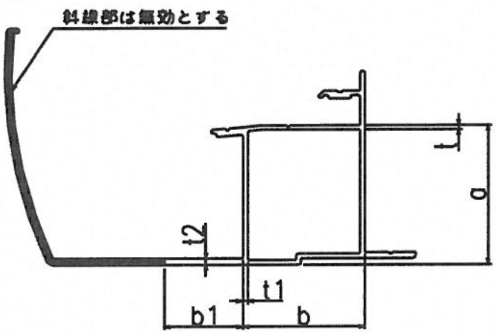
b1= 17.15 mm

9-2. Bending permissible stress degree at rear frame

Bending permissible stress degree

	Permissible stress degree for long period (N/mm2)	Permissible stress for short period(N/m3)
$b\lambda \leqq b\lambda p$	F/ν	Long period x 1.5
$b\lambda p < b\lambda \leqq b\lambda e$	$(1.0-0.5((b\lambda - b\lambda p)/(b\lambda e - b\lambda p)))F/\nu$	Long period x 1.5
$b\lambda e < b\lambda$	$(1/b\lambda^2)\cdot(F/\nu)$	Long period x 1.5

a=	3.82	cm
t=	0.12	cm
t1=	0.12	cm
b=	2.95	cm



Young's modulus factor E=	70000	N/mm^2
Shear elasticity factor of bending materialG＝	27000	Nmm
Torsion fixed number of bending material＝	4.0	cm^4
Second section moment around weak axis Iy=	7.702	cm^4
Section factor of bending direction Z=	2.344	cm^3
F:Standard strength(N/mm2)＝	132	N/mm^2
$b\lambda = \sqrt{(My/Me)}$=	0.16	
$Me = C\sqrt{((\pi^2 EIyGJ)/lb^2)}$=	12025195	Nmm
Bending moment My=	309408	Nmm
C=	1.13	
lb=	715	mm
$b\lambda p = 0.6+0.3(M2/M1)$=	0.3	
$b\lambda e = 1/\sqrt{0.5}$=	1.41	

$\nu = 3/2 + 2(b\lambda / b\lambda e)^2/3$ (its value assumes 2.17 in case more than 2.17)

ν = 1.51

$b\lambda \leqq b\lambda p$

fb= 87.5 N/mm^2

Permissible stress degree at bend parts

1) Frange plate of beam <top/bottom face>

Γb : The conversion ratio ＝ $b/t \cdot \sqrt{(F/E)}$

Γb = 0.98

a) $\Gamma b \leqq 1.34$ fc ＝ F/1.5

b) $1.34 < \Gamma b \leqq 2.69$ fc ＝ F － 0.248F Γd

c) $2.69 < \Gamma b$ fc ＝ 2.41 F/(Γd2)

fb= 88.0 N/mm^2

2) Web plate of beam <side face>

$\Gamma d = d/t \cdot \sqrt{(F/E)}$

Γd = 1.30

a) $\Gamma d \leqq 3.29$ fb ＝ F/1.5

b) $3.29 < \Gamma d \leqq 6.57$ fb ＝ F － 0.101F Γ

c) $6.57 < \Gamma d$ fb ＝ 14.4 F/(Γd^2)

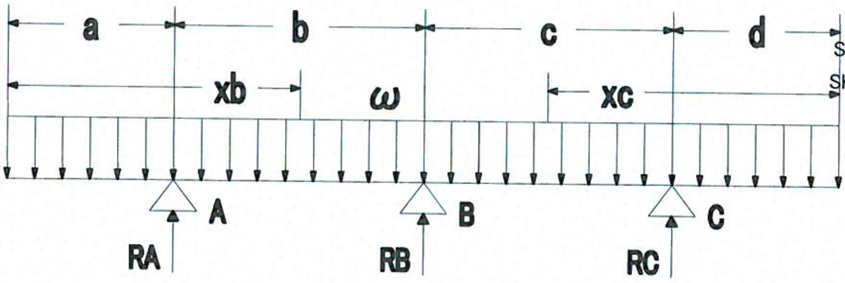
fb= 88.0 N/mm^2

Therefore, result data is…

fb= 87.5 N/mm^2

fb= 131.2 N/mm^2

9-3 Calculation of Rear Frame Section



Parts Width=	0.323 m
Long period snow ω=	19.4 N/m
Short period snow load ω=	212.9 N/m
Short period blow down ω=	156.3 N/m
Short period blow up ω=	208.9 N/m
ω=	212.9 N/m
a=	0.856 m
b=	1.3 m
c=	1.3 m
d=	0.856 m
xb=	1.078 m
xc=	1.078 m
Z=	2.344 cm^3
I=	7.702 cm^4
E=	7000000 N/cm^2

W=Full-Load M=Bend Moment
R=Anti-Power θ=Rotation Angle
Q=Shear Power δ=Bend

W= w(a+b+c+d) = 918.0 N

RA= $w(6a^2b+4a^2c+8ab^2+8abc+3b^3+4b^2c-c^3+2cd^2)/8b(b+c)$ = 376.0 N
RB= $w(4b^2c+4bc^2-4bd^2-2a^2b-2cd^2+c^3-4a^2c+b^3)/8bc$ = 165.9 N
RC= $w(6cd^2+4bd^2++8c^2d+8bcd+3c^3+4bc^2-b^3+2a^2b)/8c(b+c)$ = 376.0 N

MA= $-(wa^2/2)$ = -78.0 N・m
σA= MA/Z = 33.3 N/mm^2

MB= $w[b(2a^2-b^2)+c(2d^2-c^2)]/8(b+c)$ = -6.0 N・m
σB= MB/Z = 2.5 N/mm^2

MC= $-(wd^2/2)$ = -78.0 N・m
σC= MC/Z = 33.3 N/mm^2

MXb= $-wx^2/2+RA(x-a)$ = -40.2 (b material)
σXb= MX/Z = -17.2 N/mm^2

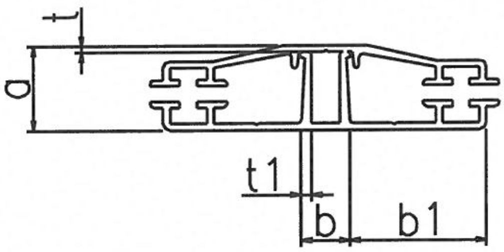
MXc= $-wx^2/2+RC(x-d)$ = -40.2 (c material)
σXc= MX/Z = 17.2 N/mm^2

σb/fb = 0.25 $<$1.0 OK !

10. Rafter / Roof retainer bending permissible stress degree

10-1 Bending permissible stress degree

a=	1.30 cm
t=	0.10 cm
t1=	0.17 cm
b=	0.72 cm
b1=	1.99 cm



Young's modulus factor E=	70000 N/mm^2
Shear elasticity factor of bending materialG=	27000 Nmm
Second section moment around weak axis Iy=	0.364 cm^4
Section factor of bending direction Z=	0.529 cm^3
F: Standard strength (N／mm2) =	132 N/mm^2

Therefore…

fb= 88.0 N/mm^2

Permissible stress degree at bend parts

Frange plate of beam <top/bottom face>

Γb : The conversion ratio $= b/t \cdot \sqrt{(F/E)}$

Γb = 0.86

a) Γb ≦ 0.438 — fb = F/1.5

b) 0.438 < Γb ≦ 0.876 — fb = F − 0.760F Γb

c) 0.876 < Γb — fb = 0.256 F/(Γb2)

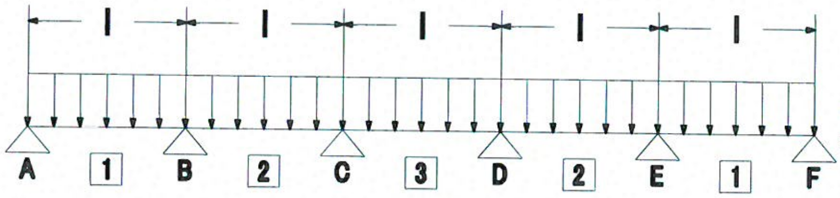
fb= 45.3 N/mm^2

Therefore…

fb= 45.3 N/mm^2

fb= 68.0 N/mm^2

10-2 Calculation of Rafter / Roof retainer section



Parts Width=	0.715 m
l=	0.645 m
Long period ω=	42.9 N/m
Short period snow load ω=	471.9 N/m
Short period blow down ω=	346.5 N/m
Short period blow up ω=	-463.1 N/m
ω=	471.9 N/m
Z=	0.529 cm^3
I=	0.364 cm^4
E=	7000000 N/cm^2

W=Full-Load　M=Bend Moment
R=Anti-Power　θ=Rotation Angle
Q=Shear Power　δ=Bend

	ωl	=	304.4 N
RA=	0.395 ＊ ωl	=	120.2 N
RB=	1.131 ＊ ωl	=	344.3 N
RC=	0.974 ＊ ωl	=	296.5 N
RD=	0.974 ＊ ωl	=	296.5 N
RE=	1.131 ＊ ωl	=	344.3 N
RF=	0.395 ＊ ωl	=	120.2 N
Rmax=			344.3 N
MB=	-0.105+ ＊ $ωl^2$	=	-20.6 N・m
MC=	-0.079 ＊ $ωl^2$	=	-15.5 N・m
MD=	-0.079 ＊ $ωl^2$	=	-15.5 N・m
ME=	-0.105+ ＊ $ωl^2$	=	-20.6 N・m
M1=	0.078 ＊ $ωl^2$	=	15.3 N・m
M2=	0.033 ＊ $ωl^2$	=	6.5 N・m
M3=	0.046 ＊ $ωl^2$	=	9.0 N・m
σX=	MX/Z	=	39.0 N/mm^2
	σb/fb	=	0.57 ＜1.0　OK !

11. Side frame bending permissible stress degree

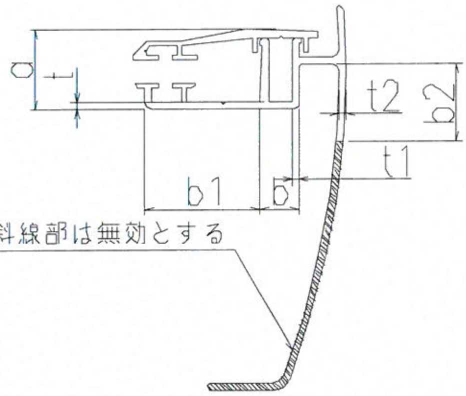
11-1 Calculation method of effective section

$\Gamma b = b/t \cdot \sqrt{(F/E)} = 0.438$ Therefore…

$b/t = 0.438/\sqrt{(F/E)} = 10.09$

Effective Depth

t2=	1.20 mm
b2=	12.10 mm



11-2 Bending permissible stress degree

a=	1.30 cm
t=	0.11 cm
t1=	0.17 cm
b=	0.72 cm
b1=	1.99 cm

Young's modulus factor E=	70000 N/mm^2
Shear elasticity factor of bending materialG＝	27000 Nmm
Second section moment around weak axis Iy=	2 cm^4
Section factor of bending direction Z=	0.324 cm^3
F:Standard strength(N／mm2)＝	132 N/mm^2

Therefore…

fb＝ 88.0 N/mm^2

Permissible stress degree at bend parts

Frange plate of beam <top/bottom face>

Γb : The conversion ratio ＝ $b/t \cdot \sqrt{(F/E)}$

Γb ＝ 0.79

a) $\Gamma b \leqq 0.438$ fb ＝ F/1.5

b) $0.438 < \Gamma b \leqq 0.876$ fb ＝ F － 0.760FΓb

c) $0.876 < \Gamma b$ fb ＝ 0.256 F/($\Gamma b2$)

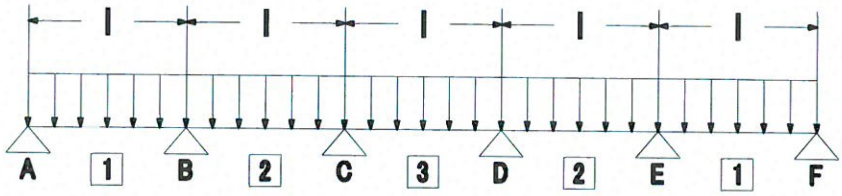
fb= 53.2 N/mm^2

Therefore…

fb= 53.2 N/mm^2

fb= 79.8 N/mm^2

11-3 Calculation of Side frame secton



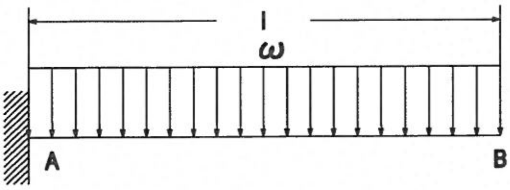
Parts Width=	0.363 m
l=	0.645 m
Long period ω=	21.8 N/m
Short period snow load ω=	239.6 N/m
Short period blow down ω=	175.9 N/m
Short period blow up ω=	-235.1 N/m
ω=	239.6 N/m
Z=	0.324 cm^3
I=	0.399 cm^4
E=	7000000 N/cm^2

W=Full-Load　M=Bend Moment
R=Anti-Power　θ=Rotation Angle
Q=Shear Power　δ=Bend

	ωl	=	154.6 N
RA=	0.395 ∗ ωl	=	61.0 N
RB=	1.131 ∗ ωl	=	174.8 N
RC=	0.974 ∗ ωl	=	150.5 N
RD=	0.974 ∗ ωl	=	150.5 N
RE=	1.131 ∗ ωl	=	174.8 N
RF=	0.395 ∗ ωl	=	61.0 N
Rmax=			174.8 N
MB=	$-0.105+ * \omega l^2$	=	-10.5 N･m
MC=	$-0.079 * \omega l^2$	=	-7.9 N･m
MD=	$-0.079 * \omega l^2$	=	-7.9 N･m
ME=	$-0.105+ * \omega l^2$	=	-10.5 N･m
M1=	$0.078 * \omega l^2$	=	7.8 N･m
M2=	$0.033 * \omega l^2$	=	3.3 N･m
M3=	$0.046 * \omega l^2$	=	4.6 N･m
σX=	MX/Z	=	32.3 N/mm^2
	σb/fb	=	0.40 <1.0　OK !

12. Corner bracket examination

12-1 Beam load



Load chart

Type			
Vertical load width (m)			1.506
l (m)	D-d1		3.225
Load ω(N/m)	Long period load		90.4
	Short period snow load		994.0
	Short period blowing up(vertical)		729.9
	Short period blowing up(vertical)		-885.1
	Short period blowing down(horizontal)		160.5
	Short period earthquake(vertical)		90.4
	Short period earthquake(horizontal)		27.1
Bending moment M(N・m)	Long period load		469.9
	Short period snow load		5168.9
	Short period blowing up(vertical)		3795.5
	Short period blowing up(vertical)		-4602.9
	Short period blowing down(horizontal)		834.7
	Short period earthquake(vertical)		469.9
	Short period earthquake(horizontal)		141.0
Maximum bending momen (N・m)	maxMx	(long period)	
		(short period)	5168.9
	maxMy	(long period)	
		(short period)	834.7
Second section moment	$Ix(cm^4)$		187.4
	$Iy(cm^4)$		53.8
Section factor	$Zx(cm^3)$		30.2
	$Zy(cm^3)$		16.1
Elasticity factor	$E(N/cm^2)$		21000000
Maximum bending stress degree (N/mm2)	max σ x		171.0
	max σ y		51.9
Vertical maximum deformation quantity	max δ x (cm)		3.42
	max δ x/l	1/	126
Flat maximum deformation quantity	max δ y (cm)		1.92
	max δ y/l	1/	225

12-2 Calculation of Corner bracket Section

Material	Second section moment		Section factor	
	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)
GB8064	205.211	65.073	28.119	20.335

fb= 420 N/mm^2
Mx= 5168.9 N・m
My= 834.7 N・m

σ bx= 183.8 N/mm^2
σ by= 41.0 N/mm^2

σ bx/fb= 0.44 ＜1.0 OK ！
σ by/fb= 0.10 ＜1.0 OK ！

13. Examination of main frame connecting part

13-1 Calculation of Load

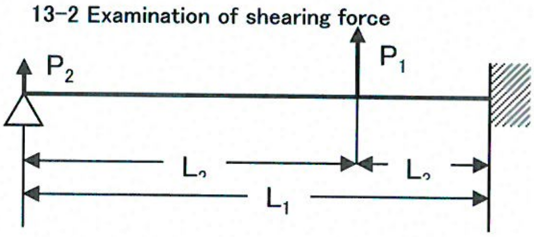
・Anti-Power of rafter

P_1= P1= 344.3 N ←from "Calculation of rafter"

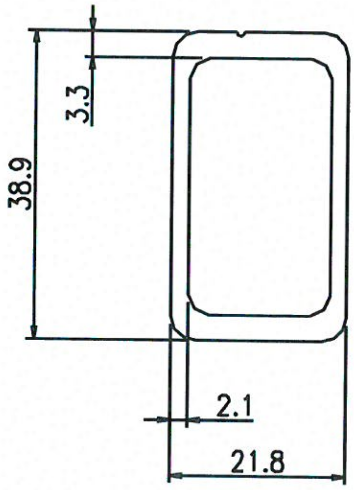
・Anti-Power of connecting rafter

P_2= P2= 172.2 N ←(Anti-Power of rafter)/2

13-2 Examination of shearing force



L_1(m)	0.86
L_2(m)	0.715
L_3(m)	0.14
A(mm^2)	276.8
fs(N/mm^2)	76.2



$Q = (P_1 \cdot L_3^2) \cdot (3L_2+2L_3)/(2L_1^3)+P_2$ より

Q= 185.4 N

τ =Q/A= 0.67 N/mm^2

τ /fs= 0.01 ＜1.0 OK ！

14. Examination of front frame connecting part

14-1 Calculation of Load

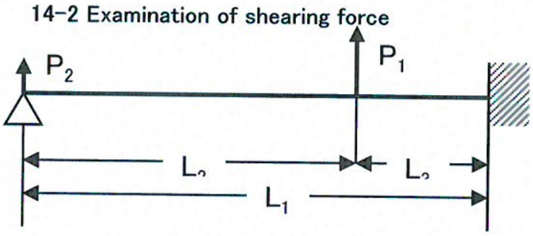
・Anti-Power of rafter

P_1= P1= 120.2 N ←from "Calculation of rafter"

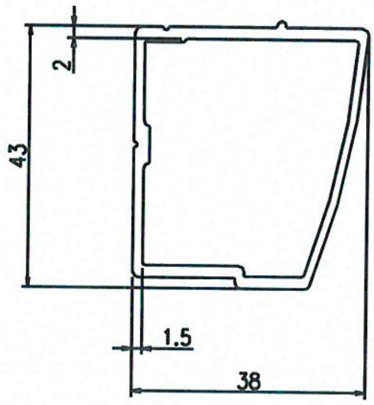
・Anti-Power of connecting rafter

P2= 60.1 N ←(Anti-Power of rafter)/2

14-2 Examination of shearing force



L_1(m)	0.86
L_2(m)	0.715
L_3(m)	0.14
A(mm^2)	261.6
fs(N/mm^2)	76.2



$Q = (P_1 \cdot L_3^2) \cdot (3L_2+2L_3)/(2L_1^3)+P_2$ より

Q= 64.7 N

τ =Q/A= 0.25 N/mm^2

τ /fs= 0.01 ＜1.0 OK ！

15. Examination of gutter connecting part

15-1 Calculation of Load

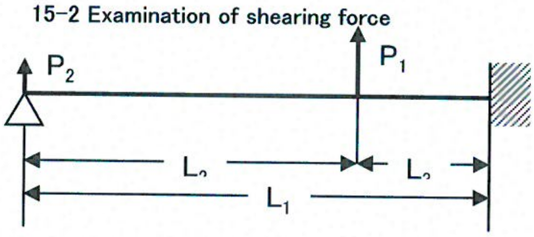
・Anti-Power of rafter

P1= 120.2 N ←from "Calculation of rafter"

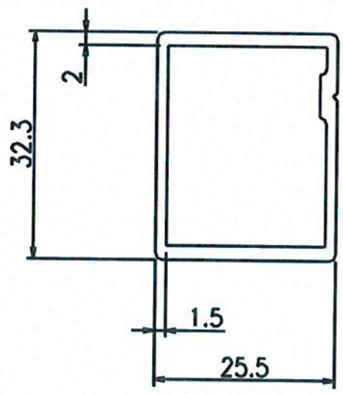
・Anti-Power of connecting rafter

P2= 60.1 N ←(Anti-Power of rafter)/2

15-2 Examination of shearing force



L_1(m)	0.86
L_2(m)	0.715
L_3(m)	0.14
A(mm^2)	192.1
fs(N/mm^2)	76.2



$Q = (P_1 \cdot L_3^2) \cdot (3L_2+2L_3)/(2L_1^3)+P_2$ より

Q= 64.7 N

τ =Q/A= 0.34 N/mm^2

τ /fs= 0.01 ＜1.0 OK ！

16. Examination of main frame and beam connection

16-1 Examination of screw pull-out force

・Pull-out force/screw

$T=$ 376.0 N

・Stretching permissible stress

$ft= 2.1\cdot\beta\cdot((d^2-d_1^2)/(P\cdot d^4))^{0.5}\cdot t^{1.2}\cdot Ft\cdot 1.5$

$=$ 172.7 N/mm^2

・Effective section

$A=$ 11.2 mm^2

$\sigma t=$ 33.5 N/mm^2

$\sigma t/ft=$ 0.19 <1.0 OK !

β	0.6
Screw diameter	5
Core diameter	3.78
Pitch	0.8
t(Thickness)	4.6
Ft(Standard strength)	100

16-2 Examination of Beam bending stress

・Beam top face bending moment

$M=$ 2109.6 N・mm

$Z=$ 58.6 mm^3

$\sigma b=$ 36.0 N/mm^2

$\sigma b/fb=$ 0.17 <1.0 OK !

b(Beam depth dimension)	61
t(Thickness)	2.4
a(load point)	18.5

17. Examination of rafter and main frame connection

17-1 Examination of screw pull-out force

・Pull-out force/screw

$T=$ 344.3 N

・Stretching permissible stress

$ft= 2.1\cdot\beta\cdot((d^2-d_1^2)/(P\cdot d^4))^{0.5}\cdot t^{1.2}\cdot Ft\cdot 1.5$

$=$ 104.5 N/mm^2

・Effective section

$A=$ 6.7 mm^2

$\sigma t=$ 51.1 N/mm^2

$\sigma t/ft=$ 0.49 <1.0 OK !

β	0.6
Screw diameter	4
Core diameter	2.93
Pitch	0.7
t(Thickness)	2.3
Ft(Standard strength)	100

17-2 Examination of Main frame bending stress

・Main frame top face bending moment

$M=$ 991.6 N・mm

$Z=$ 22.0 mm^3

$\sigma b=$ 45.0 N/mm^2

$\sigma b/fb=$ 0.22 <1.0 OK !

b(Beam depth dimension)	25
t(Thickness) center	2.3
a(load point)	10

18. Examination of Roof material

18-1 Examination of Bending volume

Poisson ratio : ν =	0.3
Distribution Load : P=	0.0116 kgf/cm^2
E: Young's modulus factor =	21000 kgf/cm^2
Thickness : h=	0.18 cm
Short edge a=	70.3 cm
Long edge b=	326.4 cm

Bending volume : Wmax

$A \cdot Wmax^3 + B \cdot Wmax + C = 0$

$A = (4\nu/a^2b^2 + (3-\nu^2)\cdot(1/a^4+1/b^4))/h^3$

= 2086.4

$B = (4/3)\cdot(1/a^2+1/b^2)^2/h$

= 33.2

$C = -256(1-\nu^2)P/(\pi^6 Eh^4)$

= -12701.0

Bending volume : Wmax= 1.82 cm

18-2 Bending stress degree

$max\,\sigma x = ((\pi^2 \cdot E \cdot Wmax)/(8\cdot(1-\nu^2)))\cdot((2-\nu^2)Wmax+4h)/a^{2+}(\nu\,(Wmax+4h))/b2)$

= 44.5 kgf/cm^2 < 551 kgf/cm^2 ∴OK !

18-3 Necessary depth of insert

Necessary depth of insert ΔL

ΔL = ΔX x SF + ΔI

However, ΔX : The gap volume by a bend

= (lx − b) / 2

lx : Arc length while bending

= 2 x sin−1[(b/2)/r] x r

r : Radius rate while bending

= (b2+4δ2)/8δ

δ : Bending rate of Polycarbonate = Wmax (cm)

b : Length of short (cm)

ΔI : The volume of expansion and contraction at temperature

= K · Δt · b/2

K : Line coefficient of expansion (cm/cm/℃)

Δt : Temperature differency at 50℃

SF : Safety ratio SF=3.0

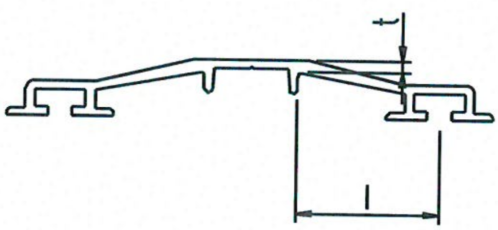
r=	339.8
lx=	70.43 cm
ΔX=	0.06 cm
K=	0.00007 cm/cm/℃
Δt =	50 ℃
SF=	3.0
ΔI=	0.12 cm

Therefore…

ΔL= 0.31 cm depth or more < 1.89 cm ∴OK !

19. Examination of Roof retainer

Rafter pitch=	715 mm
Supporting length l=	15 mm
Material thickness t=	1.2 mm
F: Standard strength=	132 N/mm^2
Blow up load ω=	383.4 N/m
Load P=ωb=	3.834 N
M=P·l=	5.8 Ncm
Section factor Z=$bt^2/6$=	0.002 cm^3
σb=M/Z=	24.0 N/mm^2



σb/fb= 0.18 <1.0 OK !

20. Ground Foundation

20-1 Without concrete floor

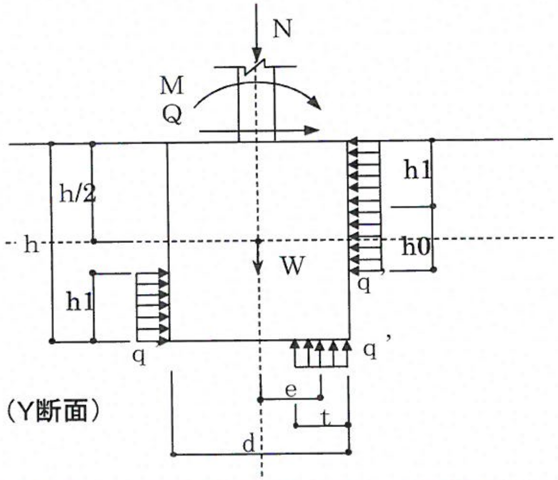
Resistance moment

M_R=(N+W) × e+q's × b × h_1 × (h_1+h_0)

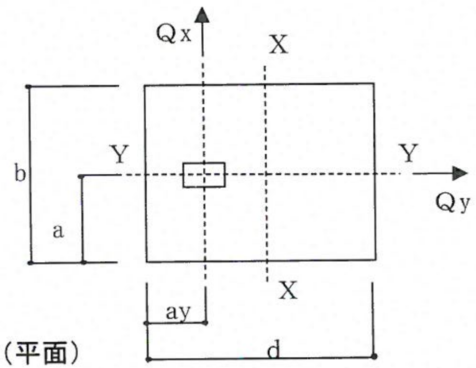
Resistance moment

M=M'+Q*(h/2)−N x (d/2−a)

Base Foundation	
Lateral Pressure	0.5
b=	0.90 m
d=	1.10 m
h=	0.55 m
ay=	0.30 m
ax=	0.45 m
Endurance strength of ground Fe=	100 KN/m²
Short Term Permissible Endurance strength of ground q=	200 KN/m²
No line concrete Volume weight	22.5 KN/m³



(Y断面)



(平面)

	Spindle Force(N)	Shear power(N)		Moment(Nm)		Foundation size(m)				Base Weight	Endurance strength of ground	Lateral Pressure
	N	Qx	Qy	M'x	M'y	b	d	h	a	W(N)	q'(kN/m2)	's(kN/m2)=0.5
Long period load	370.5	0.0	0.0	448.3	0.0	0.90	1.10	0.55	0.30	12,251	100	50.0
Short period load	3352.4	0.0	0.0	4931.3	0.0	0.90	1.10	0.55	0.30	12,251	200	100.0
Short term earthquake X	370.5	85.4	0.0	448.3	192.1	0.90	1.10	0.55	0.30	12,251	200	100.0
Short term earthquake Y	370.5	0.0	85.4	640.4	0.0	0.90	1.10	0.55	0.30	12,251	200	100.0
Short period blow down + Holizontal	2480.9	677.5	0.0	3621.1	1524.5	0.90	1.10	0.55	0.30	12,251	200	100.0
Short period blow down + Holizontal	2480.9	0.0	626.2	5030.0	0.0	0.90	1.10	0.55	0.30	12,251	200	100.0
Short period blow up+Holizontal X	-3146.8	677.5	0.0	-4839.6	1524.5	0.90	1.10	0.55	0.30	12,251	200	100.0
Short period blow up+Holizontal Y	-3146.8	0.0	-626.2	-6248.6	0.0	0.90	1.10	0.55	0.30	12,251	200	100.0

■Examination of subsidence (short period snow)

subsidence load		Endurance strength of ground	
N+W (N)	<	b×d×q (N)	
15604		198000	∴OK !

■Examination of uplift (short period blow up)

uplift load		Base weight	
N (N)	<	b×d×h×γ(N)	
3147		12251	∴OK !

	X direction							JUDGMENT	
	t(m)	e(m)	h0(m)	h1(m)	Resistance MRx	Fall Mx		MR≧M	
	(N+W)/(b×q')	(d-t)/2	Qy/(b×q's)	(h-h0)/2	MRx(N·m)	Mx(N·m)	Mx/MRx		
Long period load	0.140	0.480	0.000	0.275	9,460	355.7	0.038	<1.0	OK !
Short period load	0.087	0.507	0.000	0.275	14,712	4093.2	0.278	<1.0	OK !
Short term earthquake X	0.070	0.515	0.000	0.275	13,306	355.7	0.027	<1.0	OK !
Short term earthquake Y	0.070	0.515	0.001	0.275	13,306	571.3	0.043	<1.0	OK !
Short period blow down + Holizontal X	0.082	0.509	0.000	0.275	14,306	3000.8	0.210	<1.0	OK !
Short period blow down + Holizontal Y	0.082	0.509	0.007	0.272	14,305	4582.0	0.320	<1.0	OK !
Short period blow up+Holizontal X	0.051	0.525	0.000	0.275	11,583	-4052.9	0.350	<1.0	OK !
Short period blow up+Holizontal Y	0.051	0.525	0.007	0.272	11,582	-5634.1	0.486	<1.0	OK !

	Y direction							JUDGMENT	
	t(m)	e(m)	h0(m)	h1(m)	Resistance MRx	Fall Mx		MR≧M	
	(N+W)/(d×q')	(b-t)/2	Qx/(d×q's)	(h-h0)/2	MRy(N·m)	My(N·m)	My/Mry		
Short term earthquake X	0.057	0.421	0.001	0.275	12,124	215.6	0.018	<1.0	OK !
Short period blow down + Holizontal X	0.067	0.417	0.006	0.272	12,942	1710.8	0.132	<1.0	OK !
Short period blow up+Holizontal X	0.041	0.429	0.006	0.272	10,714	1710.8	0.160	<1.0	OK !

21-1 With concrete floor

Resistance moment

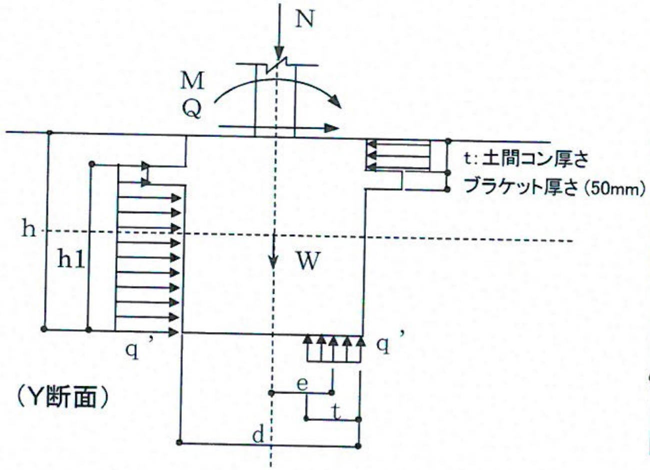
M_R=(N+W)×e+q's×b×h_1×h_1/2

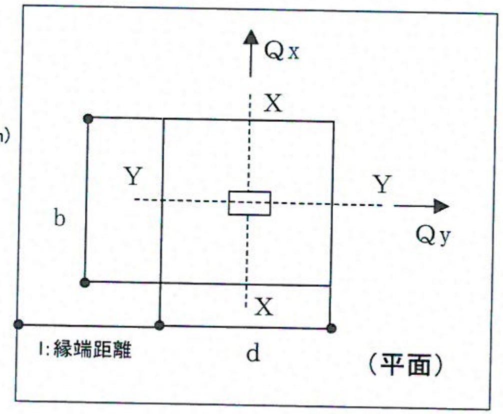
Fall moment

M=M'+Q*(h/2)

Base Foundation

Lateral Pressure	0.5	
b=	0.60	m
d=	0.45	m
h=	0.55	m
h_1=	0.45	m
l=	0.35	m
Concrete floor thickness t=	0.10	m
Endurance strength of ground Fe=	50	KN/m^2
Short Term Permissible Endurance strength of ground q=	100	KN/m^2
No line concrete Volume weight γ=	22.5	KN/m^3
Concrete standard strength Fc=	15000	KN/m^3





	Spindle Force(N)	Shear power(N)		Moment(Nm)		Foundation size(m)					Base Weight	Endurance strength of ground	Lateral Pressure
	N	Qx	Qy	M'x	M'y	b	d	h	nd part lengt	oor thicknes	W(N)	q'(kN/m2)	's(kN/m2)=0.5c
Long period load	370.5	0.0	0.0	448.3	0.0	0.60	0.45	0.55	0.35	0.10	3,341	50	25.0
Short period load	3352.4	0.0	0.0	4931.3	0.0	0.60	0.45	0.55	0.35	0.10	3,341	100	50.0
Short term earthquake X	370.5	85.4	0.0	448.3	192.1	0.60	0.45	0.55	0.35	0.10	3,341	100	50.0
Short term earthquake Y	370.5	0.0	85.4	640.4	0.0	0.60	0.45	0.55	0.35	0.10	3,341	100	50.0
Short period blow down + Holizontal X	2480.9	677.5	0.0	3621.1	1524.5	0.60	0.45	0.55	0.35	0.10	3,341	100	50.0
Short period blow down + Holizontal Y	2480.9	0.0	626.2	5030.0	0.0	0.60	0.45	0.55	0.35	0.10	3,341	100	50.0
Short period blow up+Holizontal X	-3146.8	677.5	0.0	-4839.6	1524.5	0.60	0.45	0.55	0.35	0.10	3,341	100	50.0
Short period blow up+Holizontal Y	-3146.8	0.0	-626.2	-6248.6	0.0	0.60	0.45	0.55	0.35	0.10	3,341	100	50.0

■Examination of subsidence (short period snow)

subsidence load		Endurance strength of ground	
N+W (N)	<	b×d×q (N)	
6694		27000	∴OK !

■Concrete floor panchingshere (short term wind blow up)

share force		permissible share force	
Q (N)	<	1.5×fs×t×0.9l×2(N)	
47490		94500	∴OK !

■Concrete floor bearing capacity (short term wind blow up)

share force		bearing capacity	
Q (N)	<	fc×b×0.875t/2(N)	
47490		262500	∴OK !

	X direction							
	Vertical load	t(m)	e(m)	Resistance MRx	Fall Mx		JUDGMENT	
	N+W(N)	(N+W)/(b×q')	(d-t)/2	MRx(N·m)	Mx(N·m)	Mx/MRx	MR≧M	
Long period load	3711.7	0.124	0.163	2,124	112.1	0.053	<1.0	OK !
Short period load	6693.6	0.112	0.169	4,170	1232.8	0.296	<1.0	OK !
Short term earthquake X	3711.7	0.062	0.194	3,758	112.1	0.030	<1.0	OK !
Short term earthquake Y	3711.7	0.062	0.194	3,758	162.2	0.043	<1.0	OK !
Short period blow down + Holizontal X	5822.1	0.097	0.176	4,065	905.3	0.223	<1.0	OK !
Short period blow down + Holizontal Y	5822.1	0.097	0.176	4,065	1273.1	0.313	<1.0	OK !
Short period blow up+Holizontal X	194.4	0.003	0.223	3,081	-1209.9	0.393	<1.0	OK !
Short period blow up+Holizontal Y	194.4	0.003	0.223	3,081	-1577.8	0.512	<1.0	OK !

	Y direction							
	Vertical load	t(m)	e(m)	Resistance MRx	Fall Mx		JUDGMENT	
	N+W(N)	(N+W)/(b×q')	(d-t)/2	MRx(N·m)	Mx(N·m)	Mx/MRx	MR≧M	
Short term earthquake X	3711.7	0.082	0.259	3,998	50.2	0.013	<1.0	OK !
Short period blow down + Holizontal X	5822.1	0.129	0.235	4,408	398.1	0.090	<1.0	OK !
Short period blow up+Holizontal X	194.4	0.004	0.298	3,095	398.1	0.129	<1.0	OK !

4333
POST

AS1664.1:1997-Aluminimum Structures Part 2: limit state design

Member	beam

T only

Alloy and tamper	Product	Tension		Compression	Shear		Bearing		Modulus of E
		Ftu	Fty	Fcy	Fsu	Fsy	Fbu	Fby	E
6063 T6	Extrusions	207	172	172	131	96	434	276	70000
				180					

Table 3.3(D) Page 20

T5,T6,T7,T8 & T9 only

Type of member stress	Intercept		Slope		Intersection	
Compression in columns and beam flanges	*Bc*	190.112849	*Dc*	0.99075936	*Cc*	78.6732591
Compression in flat plates	*Bp*	216.080333	*Dp*	1.20053227	*Cp*	73.7947145
Compression in round tubes under axial end loads	*Bt*	209.620466	*Dt*	6.71428412	*Ct*	trial and error
Compressive bending stress in solid rectangular bars	*Bbr*	317.096705	*Dbr*	2.61387132	*Cbr*	80.8753674
Compressive bending stress in round tubes	*Btb*	329.59479	*Dtb*	142.532382	*Ctb*	0.78029952
Shear stress in flat plate	*Bs*	120.834478	*Ds*	0.50203881	*Cs*	98.6818859
Ultimate strength of flat plates in compression	*k1*	0.35	*k2*	2.27		
Ultimate strength of flat plates in bending	*k1*	0.5	*k2*	2.04		

Table 3.4 (A) Page 21

Factor of safety	Normal buildings
φy	0.95
φu	0.85
φvp	0.9
φb	0.85
φcp	0.8
φw	0.9
φc	0.85
φv	0.8
φcc	see below

RHS/SHS section properties

Effective Length (m)	2750 mm between restraints	
Height	150 mm	
Width	95 mm	
Walls side (avg if complex shape)	1.6 mm	
Walls top/bottom (average is complex shape)	3.4 mm	CM (CANTAPORT)
Ix	4750400	475.04

Table 3.4 (b) Page 21

kt	1
kc	1.12

Iy	1610200	161.02
J (Torsion constant (warp))	3148000	314.8
Zx	63340	63.34
Zy	33900	33.9
Area	1215	12.15
Radius of gyration Rx	62.52834748 mm	
Radius of gyration Ry	36.40422351 mm	

Bending capacity

3.4.15-Compresion in beams, extreme fibre, gross section - RHS and SHS page 37

136.30 + 63 340

Limits (N)	154.7331887		
Zc	63340	Assumed to be Zx	
S1	1.792654179		
S2	2417.766287		
	mpa		
Equ-3.4.15(1): N<S1	163.4	mPa	
Equ-3.4.15(2): S1<N<S	144.834964	mPa	Add tripple to one formula
Equ-3.4.15(3): S2>N	1482.879585	mPa	

3.4.12 - Compression in beams, extreme fibre, gross section single web beams bent about strong axis Page 35

MORE ACCURATE METHOD

limts (N)	23.88818404	Note Clause Ry=Rye Page 37 Bottom Para	
Rye limit	23.88818404	Rye	115.119676

4.9 compression in single web beams and beams having sections containing tubular portions

Cb	1	Note if Ky<1 = 1	
ky	1		
rye	115.1196757		
S1	-2.570688695		
S2	94.4079109		
Equ-3.4.12(1): N<S1	163.4	mPa	
Equ-3.4.12(2): S1<N<S	144.8314837	mPa	Add tripple to one formula
Equ-3.4.12(3): S2>N	1482.263951	mPa	

3.4.22 Compression in components of bea- flat plates with both edges supported Page 41

WEBB

NOTE AMMEND SIDE WALLS FOR ODD SHAPES

Limit (N) (h/t)	89.5	
	143.2	
S1	38.36639146	
S2	90.53212769	
Equ-3.4.22(1): N<S1	190.06	
Equ-3.4.22(2): S1<N<S	136.3025247	Add tripple to one formula
Equ-3.4.22(3): S2>N	136.2373351	

FLANGE

3.4.17 compression in components of beams gross section flat plates Page 38

NOTE AMMEND TO SUIT DIFFERING TOP OR BOTTOM WALLS FOR ODD SHAPES

Limit (N) (b/t)	27	
H	91.8	Add tripple to one formula
S1	12.41378457	
S2	56.24597143	
Equ-3.4.17(1): N<S1	163.4 mPa	
Equ-3.4.17(2): S1<N<S	139.5847376 mPa	
Equ-3.4.17(3): S2>N	156.1068592 mPa	

Compression capacity

3.4.8.1-Genreal compression

	k	1		
Dc	62.79993051			
S1	0.581870399			
S2	1.241183988			
λx	0.693848678			
λy	1.191763127			
	X-X	y-y		
φcc limits λ<1.2	0.854291778	0.74972974		
φcc limits λ>1.2	0.677138815	0.74684684		
	X-X	Y-Y		
Equ-3.4.8.1 (1) N<s1	131.1948087	115.137068	mPa	
	103.9891752	114.694336	mPa	Red through and choise the correct one.
Equ-3.4.8.1 (2) s1<n<s	125.187234	86.4215032	mPa	
	99.22738052	86.0891901	mPa	
Equ-3.4.8.1 (3) N>s2	305.2144862	90.7931949	mPa	
	241.9227025	90.4440715	mPa	

86+ 1215 = 104.95W

3.4.8.10 Compression flat plates

Webb plates		
H/t See3.4.22	89.5	
S1	23.13644439	
S2	39.37218	
Equ-3.4.17 (1) N<s1	163.4	mPa
Equ-3.4.17 (2) s1<n<s	37.53949441	mPa
Equ-3.4.17 (3) N>s2	47.09368938	mPa
Flange		
H/t See3.4.17	27	
S1	23.13644439	
S2	39.37218	
Equ-3.4.17 (1) N<s1	163.4	mPa
Equ-3.4.17 (2) s1<n<s	139.5847376	mPa
Equ-3.4.17 (3) N>s2	156.1068592	mPa

~~4603~~
4330
Post-

AS1664.1:1997-Aluminimum Structures Part 2: limit state design

Member	beam

T only

Alloy and tamper	Product	Tension		Compression	Shear		Bearing		Modulus of E
		Ftu	Fty	Fcy	Fsu	Fsy	Fbu	Fby	E
6063 T6	Extrusions	207	172	172	131	96	434	276	70000
				180					

Table 3.3(D) Page 20

T5,T6,T7,T8 & T9 only

Type of member stress	Intercept		Slope		Intersection	
Compression in columns and beam flanges	*Bc*	190.112849	*Dc*	0.99075936	*Cc*	78.6732591
Compression in flat plates	*Bp*	216.080333	*Dp*	1.20053227	*Cp*	73.7947145
Compression in round tubes under axial end loads	*Bt*	209.620466	*Dt*	6.71428412	*Ct*	trial and error
Compressive bending stress in solid rectangular bars	*Bbr*	317.096705	*Dbr*	2.61387132	*Cbr*	80.8753674
Compressive bending stress in round tubes	*Btb*	329.59479	*Dtb*	142.532382	*Ctb*	0.78029952
Shear stress in flat plate	*Bs*	120.834478	*Ds*	0.50203881	*Cs*	98.6818859
Ultimate strength of flat plates in compression	*k1*	0.35	*k2*	2.27	[redacted]	
Ultimate strength of flat plates in bending	*k1*	0.5	*k2*	2.04		

Table 3.4 (A) Page 21

Factor of safety	Normal buildings
φy	0.95
φu	0.85
φvp	0.9
φb	0.85
φcp	0.8
φw	0.9
φc	0.85
φv	0.8
φcc	see below

RHS/SHS section properties		
Effective Length (m)	2750 mm between restraints	
Height	150 mm	
Width	95 mm	
Walls side (avg if complex shape)	1.6 mm	
Walls top/bottom (average is complex shape)	4.4 mm	CM (CANTAPORT)
Ix	5636200	563.62

Table 3.4 (b) Page 21

kt	1
kc	1.12

Iy	1732300	173.23
J (Torsion constant (warp))	3296000	329.6
Zx	75150	75.15
Zy	36470	36.47
Area	1390	13.9
Radius of gyration Rx	63.67746967 mm	
Radius of gyration Ry	35.30239358 mm	

Bending capacity

3.4.15-Compresion in beams, extreme fibre, gross section - RHS and SHS page 37

Limits (N)	172.9762669	
Zc	75150	Assumed to be Zx
S1	1.792654179	
S2	2417.766287	
	mpa	
Equ-3.4.15(1): N<S1	163.4 mPa	
Equ-3.4.15(2): S1<N<S	143.8744269 mPa	Add tripple to one formula
Equ-3.4.15(3): S2>N	1326.486522 mPa	

3.4.12 - Compression in beams, extreme fibre, gross section single web beams bent about strong axis Page 35 **MORE ACCURATE METHOD**

limts (N)	25.25544602	Note Clause Ry=Rye Page 37 Bottom Para	
Rye limit	25.25544602	Rye	108.887406

4.9 compression in single web beams and beams having sections containing tubular portions

Cb	1	Note if Ky<1 = 1
ky	1	
rye	108.8874058	
S1	-2.570688695	
S2	94.4079109	
Equ-3.4.12(1): N<S1	163.4 mPa	
Equ-3.4.12(2): S1<N<S	143.8719558 mPa	Add tripple to one formula
Equ-3.4.12(3): S2>N	1326.116668 mPa	

3.4.22 Compression in components of bea- flat plates with both edges supported Page 41

WEBB

NOTE AMMEND SIDE WALLS FOR ODD SHAPES

Limit (N) (h/t)	88.25
	141.2
S1	38.36639146
S2	90.53212769

Equ-3.4.22(1): N<S1	190.06	
Equ-3.4.22(2): S1<N<!	138.1632744	Add tripple to one formula
Equ-3.4.22(3): S2>N	138.1670424	

138.16 + 75150

FLANGE

3.4.17 compression in components of beams gross section flat plates Page 38

NOTE AMMEND TO SUIT DIFFERING TOP OR BOTTOM WALLS FOR ODD SHAPES

Limit (N) (b/t)	20.86363636	
H	91.8	Add tripple to one formula
S1	12.41378457	
S2	56.24597143	

Equ-3.4.17(1): N<S1	163.4	mPa
Equ-3.4.17(2): S1<N<!	149.6037251	mPa
Equ-3.4.17(3): S2>N	202.0206414	mPa

Compression capacity

3.4.8.1-Genreal compression

	k	1
Dc	62.79993051	
S1	0.581870399	
S2	1.241183988	
λx	0.681327501	
λy	1.22895948	
	X-X	y-y
φcc limits λ<1.2	0.856921225	0.74191851
φcc limits λ>1.2	0.67538585	0.75205433

	X-X	Y-Y		
Equ-3.4.8.1 (1) N<s1	131.5986167	113.937485	mPa	
	103.7199698	115.494057	mPa	Red through
Equ-3.4.8.1 (2) s1<n<!	126.2463732	83.7880321	mPa	and choise
	99.50157799	84.9327134	mPa	the correct
Equ-3.4.8.1 (3) N>s2	317.5100739	84.4908199	mPa	one.
	250.2468196	85.6451025	mPa	

84.93 x 1390

3.4.8.10
Compression flat plates

Webb plates

H/t See3.4.22	88.25	
S1	23.13644439	
S2	39.37218	
Equ-3.4.17 (1) N<s1	163.4	mPa
Equ-3.4.17 (2) s1<n<s	39.58039927	mPa
Equ-3.4.17 (3) N>s2	47.7607388	mPa

Flange

H/t See3.4.17	20.86363636	
S1	23.13644439	
S2	39.37218	
Equ-3.4.17 (1) N<s1	163.4	mPa
Equ-3.4.17 (2) s1<n<s	149.6037251	mPa
Equ-3.4.17 (3) N>s2	202.0206414	mPa

4333 Beam

AS1664.1:1997-Aluminimum Structures Part 2: limit state design

Member	beam

T only

Alloy and tamper	Product	Tension		Compression	Shear		Bearing		Modulus of E
		Ftu	Fty	Fcy	Fsu	Fsy	Fbu	Fby	E
6063 T6	Extrusions	207	172	172	131	96	434	276	70000
				180					

Table 3.3(D) Page 20

T5,T6,T7,T8 & T9 only

Type of member stress	Intercept		Slope		Intersection	
Compression in columns and beam flanges	***Bc***	190.112849	***Dc***	0.99075936	***Cc***	78.6732591
Compression in flat plates	***Bp***	216.080333	***Dp***	1.20053227	***Cp***	73.7947145
Compression in round tubes under axial end loads	***Bt***	209.620466	***Dt***	6.71428412	***Ct***	trial and error
Compressive bending stress in solid rectangular bars	***Bbr***	317.096705	***Dbr***	2.61387132	***Cbr***	80.8753674
Compressive bending stress in round tubes	***Btb***	329.59479	***Dtb***	142.532382	***Ctb***	0.78029952
Shear stress in flat plate	***Bs***	120.834478	***Ds***	0.50203881	***Cs***	98.6818859
Ultimate strength of flat plates in compression	***k1***	0.35	***k2***	2.27		
Ultimate strength of flat plates in bending	***k1***	0.5	***k2***	2.04		

Table 3.4 (A) Page 21

Factor of safety	Normal buildings
φy	0.95
φu	0.85
φvp	0.9
φb	0.85
φcp	0.8
φw	0.9
φc	0.85
φv	0.8
φcc	see below

RHS/SHS section properties

Effective Length (m)	3300	mm between restraints
Height	124	mm
Width	67	mm
Walls side (avg if complex shape)	1.5	mm
Walls top/bottom (average is complex shape)	2.2	mm
Ix	1873900	

CM (CANTAPORT)
187.39

Table 3.4 (b) Page 21

kt	1
kc	1.12

Iy	538500	53.85
J (Torsion constant (warp))	1147000	114.7
Zx	30220	30.22
Zy	16070	16.07
Area	775	7.75
Radius of gyration Rx	49.1725074 mm	
Radius of gyration Ry	26.35979343 mm	

Bending capacity

136.17 × 30220 = 4.11

3.4.15-Compresion in beams, extreme fibre, gross section - RHS and SHS page 37

Limits (N)	253.7837631		
Zc	30220	Assumed to be Zx	
S1	1.792654179		
S2	2417.766287		
	mpa		
Equ-3.4.15(1): N<S1	163.4	mPa	
Equ-3.4.15(2): S1<N<S	140.1305206	mPa	Add tripple to one formula
Equ-3.4.15(3): S2>N	904.1188606	mPa	

3.4.12 - Compression in beams, extreme fibre, gross section single web beams bent about strong axis Page 35 **MORE ACCURATE METHOD**

limts (N)	30.63602915	Note Clause Ry=Rye Page 37 Bottom Para	
Rye limit	30.63602915	Rye	107.71631

4.9 compression in single web beams and beams having sections containing tubular portions

Cb	1	Note if Ky<1 = 1	
ky	1		
rye	107.7163096		
S1	-2.570688695		
S2	94.4079109		
Equ-3.4.12(1): N<S1	163.4	mPa	
Equ-3.4.12(2): S1<N<S	140.0959278	mPa	Add tripple to one formula
Equ-3.4.12(3): S2>N	901.2118034	mPa	

3.4.22 Compression in components of bea- flat plates with both edges supported Page 41

WEBB

NOTE AMMEND SIDE WALLS FOR ODD SHAPES

Limit (N) (h/t)	79.73333333
	119.6
S1	38.36639146
S2	90.53212769

Equ-3.4.22(1): N<S1	190.06	
Equ-3.4.22(2): S1<N<!	150.841182	Add tripple to one formula
Equ-3.4.22(3): S2>N	152.9252696	

FLANGE

3.4.17 compression in components of beams gross section flat plates Page 38

NOTE AMMEND TO SUIT DIFFERING TOP OR BOTTOM WALLS FOR ODD SHAPES

Limit (N) (b/t)	29.09090909	
H	64	Add tripple to one formula
S1	12.41378457	
S2	56.24597143	

Equ-3.4.17(1): N<S1	163.4	mPa
Equ-3.4.17(2): S1<N<!	136.1708604	mPa
Equ-3.4.17(3): S2>N	144.8866787	mPa

Compression capacity

3.4.8.1-Genreal compression

	k	1
Dc	62.79993051	
S1	0.581870399	
S2	1.241183988	
λx	1.058767516	
λy	1.975063031	
	X-X	y-y
φcc limits λ<1.2	0.777658822	0.58523676
φcc limits λ>1.2	0.728227452	0.85650882

	X-X	Y-Y		
Equ-3.4.8.1 (1) N<s1	119.4261762	89.8756458	mPa	
	111.8349302	131.535284	mPa	Red through and choise the correct one.
Equ-3.4.8.1 (2) s1<n<!	96.13598985	38.6718765	mPa	
	90.02516915	56.5972707	mPa	
Equ-3.4.8.1 (3) N>s2	119.3208486	25.8046591	mPa	
	111.7362976	37.7657721	mPa	

38.67 775 = 29.96

3.4.8.10
Compression flat plates

Webb plates		
H/t See3.4.22	79.73333333	
S1	23.13644439	
S2	39.37218	
Equ-3.4.17 (1) N<s1	163.4	mPa
Equ-3.4.17 (2) s1<n<s	53.48576441	mPa
Equ-3.4.17 (3) N>s2	52.86227257	mPa
Flange		
H/t See3.4.17	29.09090909	
S1	23.13644439	
S2	39.37218	
Equ-3.4.17 (1) N<s1	163.4	mPa
Equ-3.4.17 (2) s1<n<s	136.1708604	mPa
Equ-3.4.17 (3) N>s2	144.8866787	mPa

2. 5,000 SERIES

Canter 3.0
Post 2750

STATIC REPORT

PJR－series

5030-H23

2016. 09. 23
SankyoTateyama,Inc.

1. Material and Evaluation

①Post

Materi A6063S-T6(SS)

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N/mm2
DE8389	15.92	662.16	188.59	88.29	39.70	70000	3.44	180

Material evaluation (without support and side panel Vex=38m/s)

Snow for short period

σb/fb+σc/fc= 0.60 <1.0 OK !

Wind blow up

σb/fb+σc/fc= 0.61 <1.0 OK !

Wind blow down

σb/fb+σt/ft= 0.68 <1.0 OK !

2・lk/i= 118.5 <140 OK !

②Beam

Materi A6063S-T6(SS)

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N/mm2
DE8393	9.06	231.70	60.75	37.37	18.13	70000	2.59	180

Material evaluation (without support and side panel Vex=38m/s)

Snow for short period

σb/fb= 0.81 <1.0 OK !

Wind blow up

σbx/fbx= 0.60 <1.0 OK !

Wind blow down

σbx/fbx= 0.80 <1.0 OK !

③Main frame

Materi A6063S-T6(SS)

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N/mm2
DE8579有	1.75	5.80	2.13	2.51	0.93	70000	1.10	180

Material evaluation

σb/fb= 0.49 <1.0 OK !

④Front frame

Materi A6063S-T5

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N/mm2
DE8401	2.55	12.50	6.91	3.81	2.20	70000	1.65	132

Material evaluation

σb/fb= 0.25 <1.0 OK !

⑤Rear frame

Materi A6063S-T5

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N/mm2
DE8404有	2.55	7.70	5.90	2.34	1.82	70000	1.52	132

Material evaluation

σb/fb= 0.35 <1.0 OK !

⑥Rafter

Materi A6063S-T5

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N／mm2
DE8654+DE8666	1.88	0.36	3.75	0.53	1.48	70000	1.41	132

Material evaluation

σb/fb= 0.47 ＜1.0 OK !

⑦Side frame

Materi A6063S-T5

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N／mm2
DE8683+DE8412	1.65	0.40	2.00	0.32	0.93	70000	1.10	132

Material evaluation

σb/fb= 0.33 ＜1.0 OK !

⑧Corner bracket

Materi SPFH590

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N／mm2
GB8064	8.58	205.21	65.07	28.12	20.34	210000	2.75	420

Material evaluation (without support and side panel Vex=38m/s)

σbx/fb= 0.60 ＜1.0 OK !

σby/fb= 0.08 ＜1.0 OK !

⑨Main frame connecting parts

Materi A6063S-T5

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N／mm2
GB8086	2.77	5.59	1.85	2.87	1.69	70000	0.82	132

Material evaluation

τ/fs= 0.01 ＜1.0 OK !

⑩Front frame connecting parts

Materi A6063S-T5

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N／mm2
GB8084	2.62	6.94	4.75	2.95	2.26	70000	1.35	132

Material evaluation

τ/fs= 0.01 ＜1.0 OK !

⑪Rear frame connecting parts

Materi A6063S-T5

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N／mm2
GB8085	1.92	2.92	1.83	1.78	1.40	70000	0.98	132

Material evaluation

τ/fs= 0.01 ＜1.0 OK !

⑫**Roof material**

Material polycarbonat

Material performance

Material	Thickness	Length(short part)	Length(long part)	Inserting	Poisson ratio	Elasticity factor	F value
	cm	cm	cm	cm	ν	kgf/cm2	kgf/cm2
GB4107	0.18	70.3	296.2	1.89	0.3	21000	551

Material evaluation

Bending volume : Wmax= 1.82 cm

max σ x= 44.44 kgf/cm^2 < 551.0 kgf/cm^2 ∴OK !

Necessary depth of insert ΔL 0.31 cm depth or < 1.89 cm ∴OK !

⑬**Roof retainer**

Materi A6063S-T5

Material performance

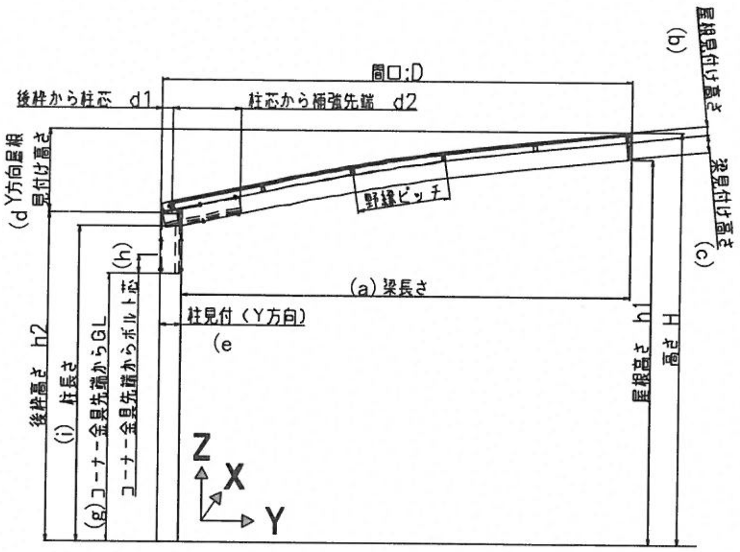
Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N/mm2
DE8411	0.79	0.03	1.84	0.08	0.72	70000	1.52	132

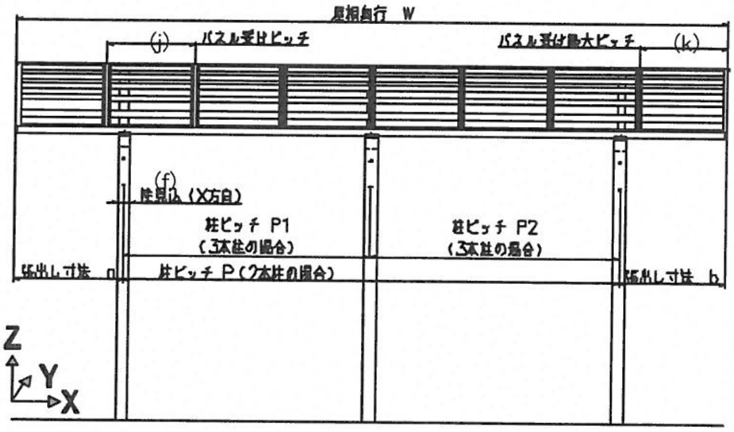
Material evaluation

σb/fb= 0.18 <1.0 OK !

2. Carport detail

type	5030-H23
Roof projection A=	15.08 m^2
Burden projection per post=	7.54 m^2
Depth : D=	3.000 m
Roof length : W=	5.027 m
from rear frame to post core d1=	0.075 m
om post core to reinforcing end d2=	0.484 m
(a)Beam length=	2.850 m
Overhang length b=	1.064 m
(b) Roof part thickness	2.900 m
(c) Beam thickness	1.064 m
(d) Y direction roof part height=	0.065 m
(e) Post dimension(Y direction)=	0.124 m
(f) Post dimension(X direction)=	0.551 m
Overall Height(GL to Roof end) H=	0.150 m
Overall Height(GL to Beam) h1=	0.095 m
verall Height(GL to Rear frame) h2=	2.899 m
om the end of corner bracket to GL=	2.710 m
orner bracket to the center of bolts=	2.348 m
(i) Post length=	1.910 m
Post quantity=	0.130 m
(j) Rafter pitch=	2.250 m
(k) Rafter maximum span=	2
(m) Main frame pitch=	0.715 m
(s) Rafter maximum span=	0.726 m
(t) Main frame pitch=	0.585 m





3. **Load design**

①Vertical over load (G)

Part Weight

Roof	60.0 N/m^2
Post	42.1 N/m

②Snow over load

Post quantity	Snow area	Snow quantity	Unit weight	Short period snow period
2 posts type	General area	20 cm	30 $N/m^2/cm$	600 N/m^2

③ Wind blowing load(Vex=38m/s)

・For design of structure frame

Speed pressureq $= 0.6E(Vex \cdot y)^2 =$ 708 N/m^2

Standard wind speedVex= 38 m/s

$E = Er^2 Gf =$ 1.194

$Er = 1.7(Zb/Z_G)^{\alpha} =$ 0.691

Ground surface Div. Ⅲ

Gust influence factor Gf= 2.5

Zb= 5

$Z_G =$ 450

$\alpha =$ 0.2

Installation period factor y= 0.827

・For roof material design

Average speed pressureq' $= 0.6Er2(Vex \cdot y)^2 =$ 283 N/m^2

④Earthquake power

Earthquake power Qi=Z・Rt・Ai・Co・Wi

Area factorZ= 1.0

Vibration feature Rt= 1.0

Coat shear power distribution factorAi= 1.0

Standard shear power factorC_o = 0.3

4. Preparing calculation

4-1 Carport load (For earthquake power calculation)

Roof	452	N
Post	95	N
Wi=	547	N

Earthquake power Qi=Z・Rt・Ai・Co・Wi= 164.2 N

4-2 Wind pressure power calculation (Maximum wind power pressure for 1 post)

・For design of structure frame

Wind factor		
Independent shed	10 °	
C=	0.60	(+pressure)
	-1.00	(-pressure)
	1.2	(Post flat power, side panel)

Wind pressureW=q C=	425 N/m^2	(Wind blow down)
	-708 N/m^2	(Wind blow up)
	849 N/m^2	(Flat)

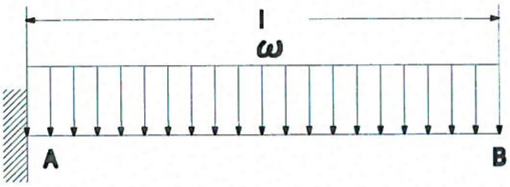
・Roof material design

Peak with factor calculation process Gpe=	3.1 (+pressure)				
	3.0 (-pressure: panel center part)				
	4.0 (-pressure: panel surrounding part)				
Peak wind factor Cf=	3.1	x	0.60	=	1.86
	3.0	x	-1.00	=	-3.00
	4.0	x	-1.00	=	-4.00

Wind pressure W=q' Cf=	527 N/m^2	(Wind blow down)
	-849 N/m^2	(Wind blow up)
	-1132 N/m^2	(Wind blow up)

5. Beam material examination

5-1 Beam load(without support Vex=38m/s)



Load chart

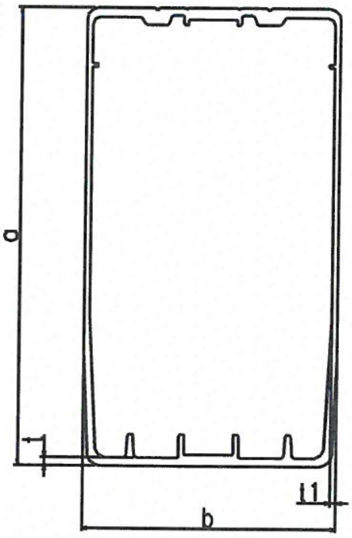
Type			
Vertical load width (m)	Total/post quantity		2.514
l (m)	D-d1-d2		2.441
Load ω(N/m)	Long period load		150.8
	Short period load		1658.9
	Short period blowing down(vertical)		1218.1
	Short period blowing up(vertical)		-1628.1
	Short period blowing down(horizontal)		133.8
	Short period earthquake(vertical)		150.8
	Short period earthquake(horizontal)		45.2
Bending moment M(N･m)	Long period load		449.3
	Short period load		4942.3
	Short period blowing down(vertical)		3629.1
	Short period blowing up(vertical)		-4850.4
	Short period blowing (horizontal)		398.5
	Short period earthquake(vertical)		449.3
	Short period earthquake(horizontal)		134.8
Maximum bending mom (N･m)	maxMx	(long period)	
		(short period)	4942.3
	maxMy	(long period)	
		(short period)	398.5
Second section mome	Ix(cm^4)		231.7
	Iy(cm^4)		60.7
Section factor	Zx(cm^3)		37.4
	Zy(cm^3)		18.1
Elasticity factor	E(N/cm^2)		7000000
Maximum bending stre (N/mm2)	max σx		132.3
	max σy		22.0
Vertical maximum defo	max δx	(cm)	4.54
	max δx/l	1/	111
Flat maximum deforma	max δy	(cm)	1.40
	max δy/l	1/	360

5-2 Beam permissible stress degree

Bending permissible stress degree

	Permissible stress degree for long period (N／mm2)	Permissible stress for short period(N/m3)
bλ≦bλp	F/ν	Long period x 1.5
bλp<bλ≦bλe	(1.0−0.5((bλ−bλp)/(bλe−bλp)))F/ν	Long period x 1.5
bλe<bλ	(1/bλ²)・(F/ν)	Long period x 1.5

a=	12.40	cm
t=	0.38	cm
t1=	0.15	cm
b=	6.70	cm
Young's modulus factor E=	70000	N/mm^2
Shear elasticity factor of bending materialG＝	27000	Nmm
Torsion fixed number of bending material＝	127.3	cm^4
Second section moment around weak axis Iy=	60.745	cm^4
Section factor of bending direction Z=	37.37	cm^3
F:Standard strength(N／mm2)＝	180	N/mm^2
bλ=√(My/Me)=	0.14	
Me=C√((π²EIyGJ)/lb²)=	359491633	Nmm
Bending moment My=	6726600	Nmm
C=1.75+1.05(M2/M1)+0.3(M2/M1)²=	1.75	
M2=	0	Nm
M1=	4850	Nm
M2/M1=	0	
lb＝	584.7	mm
bλp=0.6+0.3(M2/M1)=	0.6	
bλe=1／√0. 5=	1.41	



ν=3/2+2(bλ/bλe)²/3 (its value assumes 2.17 in case more than 2.17)

ν= 1.51

bλ≦bλp

Permissible stress degree fb: F／ν＝ 119.5 N/mm^2

Permissible stress degree at bend parts (strong axis)

1) Frange plate of beam <top/bottom face>

Γb :The conversion ratio = b/t・√(F/E)

Γb = 0.85

a) Γb ≦ 1.34 fb = F/1.5

b) 1.34 < Γb ≦ 2.69 fb = F − 0.248FΓb

c) 2.69 < Γb fb = 2.41 F/($Γb^2$)

fb= 120.0 N/mm^2

2) Web plate of beam <side face>

Γd : The conversion ratio = d/t・√(F/E)

Γd = 3.94

a) Γd ≦ 3.29 fb = F/1.5

b) 3.29 < Γd ≦ 6.57 fb = F − 0.101FΓ

c) 6.57 < Γd fb = 14.4 F/($Γd^2$)

fb= 108.5 N/mm^2

Therefore, result data is…

fbx= 108.5 N/mm^2

fbx= 162.7 N/mm^2

Permissible stress degree at bend parts (weak axis)

1) Frange plate of beam <top/bottom face>

Γb : = b/t・√(F/E)

Γb = 3.94

a) Γb ≦ 1.34 fb = F/1.5

b) 1.34 < Γb ≦ 2.69 fb = F − 0.248FΓb

c) 2.69 < Γb fb = 2.41 F/($Γb^2$)

fb= 28.0 N/mm^2

2) Web plate of beam <side face>

Γd :The conversion ratio = d/t・√(F/E)

Γd = 0.85

a) Γd ≦ 3.29 fb = F/1.5

b) 3.29 < Γd ≦ 6.57 fb = F − 0.101FΓ

c) 6.57 < Γd fb = 14.4 F/($Γd^2$)

fb= 120.0 N/mm^2

Therefore, result data is…

fby= 28.0 N/mm^2

fby= 42.0 N/mm^2

Section of the Beam examination

Snow for short period

M= 4942.3 N・m

σb= 132.3 N/mm^2

σb/fb= 0.81 <1.0 OK !

Wind blow down

M= 3629.1 N・m

σbx= 97.1 N/mm^2

σbx/fbx= 0.60 <1.0 OK !

Wind blow up

M= −4850.4 N・m

σbx= 129.8 N/mm^2

σbx/fbx= 0.80 <1.0 OK !

Wind blow horizontal

M= 398.5

σby= 22.0

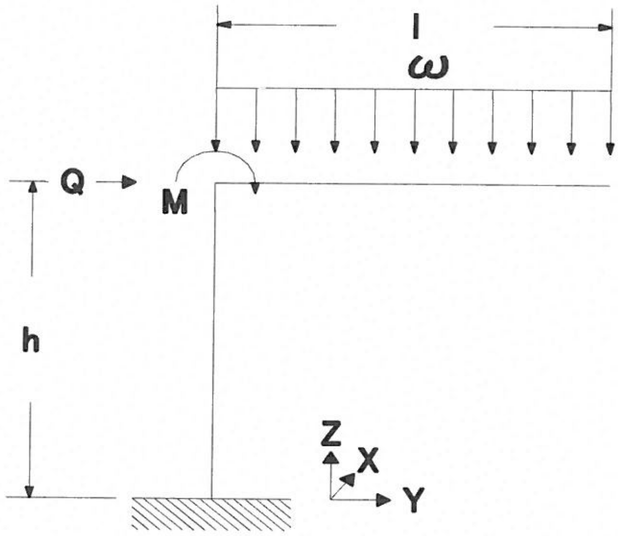
σby/fby= 0.52 <1.0 OK !

6. Post material examination

6-1 Post load

Load chart

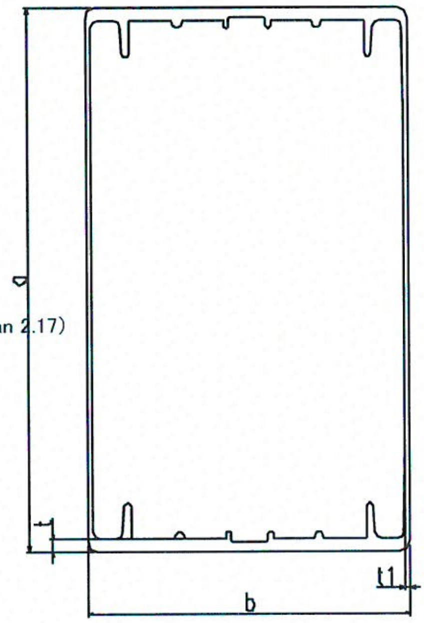
Type		
Vertical load width (m)	Total/post quantity	2.514
l (m)	D-d1	2.850
Load ω(N/m)	Long period load	150.8
	Short period load	1658.9
	Short period blowing up(vertical)	1218.1
	Short period blowing down(vertical)	−1628.1
	Short period earthquake(vertical)	150.8
Axial force by vertical load N(N)	Long period load	547.2
	Short period load	5071.5
	Short period blowing up(vertical)	3749.2
	Short period blowing down(vertical)	−4789.4
	Short period earthquake(vertical)	547.2
Flat load Q(N)	Short period wind X	637.4
	Short period wind Y	980.0
	Short period earthquakeX、Y	135.7
Bending moment M(N・m)	Long period load	612.5
	Short period load	6737.2
	Short period blowing up(vertical)	4947.2
	Short period blowing down(vertical)	−6612.0
	Short period earthquake(vertical)	612.5
Bending moment by vertical and flat load Mx(N・m)	Short period blowing up(vertical)+WindY	7152.2
	Short period blowing down(vertical)+WindY	−8817.0
	Short period earthquake(vertical) + Earthquak	917.9
Bending moment by flat load My(N・m)	Short period windX	1434.2
	Short period earthquakeX	305.4
Maximum bending moment(N・m)	maxMx (long period)	
	(short period)	8817.0
	maxMy (short period wind)	1434.2
	(short period earthqua	305.4
Second section moment	Ix(cm4)	662.155
	Iy(cm4)	188.59
Section factor	Zx(cm3)	88.287
	Zy(cm3)	39.70
Max. bending stress deg. σx(N/mm2)	Long period load	6.94
	Short period load	76.31
	Short period blowing up(vertical)	56.04
	Short period blowing down(vertical)	−74.89
	Short period earthquake(vertical)	6.94
	Short period blowing up(vertical)+WindY	81.01
	Short period blowing down(vertical)+WindY	−99.87
	Short period earthquake(vertical) + Earthquak	10.40
max σx(N/mm2) (uniaxial bending)	Long period	6.94
	Short period(Y direction Vertical load)	99.87
Bending stress degree σy(N/mm2)	Short period windX	36.12
	Short period earthquakeX	7.69



6-2 Post permissible stress degree

Permissible pressure stress degree

	Permissible stress degree for long period (N/mm2)	For short period(N/m3)
$c\lambda \leqq c\lambda p$	F/ν	Long period x 1.5
$c\lambda p < c\lambda \leqq c\lambda e$	$(1.0-0.5((c\lambda - c\lambda p)/(c\lambda e - c\lambda p)))F/\nu$	Long period x 1.5
$c\lambda e < c\lambda$	$(1/c\lambda^2)\cdot(F/\nu)$	Long period x 1.5



a=	15.00	cm
t=	0.56	cm
t1=	0.16	cm
b=	9.50	cm
$c\lambda=(lk/i)\sqrt{(F/\pi^2E)}$=	1.9	
lk:Buckling length(cm)=	407.96	cm
Standard strength F(N/mm2)=	180	N/mm^2
E:Young's modulus factor(N/mm2)=	70000	N/mm^2
$c\lambda p$=	0.2	
$c\lambda e=1/\sqrt{0.5}$=	1.41	

$\nu=3/2+2(c\lambda/c\lambda e)2/3$ (its value assumes 2.17 in case more than 2.17)

ν=	2.17	
H=	203.98	cm
Section second radius i(cm)=	3.44	cm
$c\lambda e < c\lambda$		
fc=	34.8	N/mm^2

Permissible stress degree at bend parts

1) Frange plate of beam <top/bottom face>

$\Gamma d := d/t\cdot\sqrt{(F/E)}$

Γd = 0.83

a) $\Gamma d \leqq 1.34$ fb = F/1.5
b) $1.34 < \Gamma d \leqq 2.69$ fb = F − 0.248FΓd
c) $2.69 < \Gamma d$ fb = $2.41\ F/(\Gamma d^2)$

fc= 120.0 N/mm^2

2) Web plate of beam <side face>

$\Gamma d := d/t\cdot\sqrt{(F/E)}$

Γd = 4.40

a) $\Gamma d \leqq 1.34$ fb = F/1.5
b) $1.34 < \Gamma d \leqq 2.69$ fb = F − 0.248FΓd
c) $2.69 < \Gamma d$ fb = $2.41\ F/(\Gamma d^2)$

fc= 22.4 N/mm^2

Therefore, result date is･･･

fc= 22.4 N/mm^2

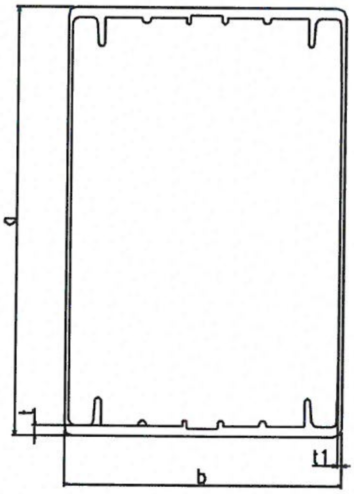
fc= 33.6 N/mm^2

6-3 Permissible stress degree at bend parts

Permissible bending stress degree

	Permissible stress degree for long period (N/mm2)	For short period(N/m3)
bλ≦bλp	F/ν	Long period x 1.5
bλp<bλ≦bλe	(1.0−0.5((bλ−bλp)/(bλe−bλp)))F/ν	Long period x 1.5
bλe<bλ	(1/bλ²)・(F/ν)	Long period x 1.5

a=	15.00	cm
t=	0.56	cm
t1=	0.16	cm
b=	9.50	cm



Young's modulus factor E=	70000	N/mm^2
Shear elasticity factor of bending material G=	27000	Nmm
Torsion fixed number of bending material=	340.2	cm^4
Second section moment around weak axis Iy=	188.588	cm^4
Section factor of bending direction Z=	88.287	cm^3
F:Standard strength(N/mm2)=	180	N/mm^2
$b\lambda=\sqrt{(My/Me)}$=	0.30	
$Me=C\sqrt{((\pi^2 EIyGJ)/lb^2)}$=	181147397	Nmm
Bending moment My=	15891660	Nmm
$C=1.75+1.05(M2/M1)+0.3(M2/M1)^2$=	1	
M2=	-6612.0	Nm
M1=	6612.0	Nm
M2/M1=	-1	
lb=	1909.8	mm
$b\lambda p=0.6+0.3(M2/M1)$=	0.3	
$b\lambda e=1/\sqrt{0.5}$=	1.41	

$\nu=3/2+2(b\lambda/b\lambda e)^2/3$ (its value assumes 2.17 in case more than 2.17)

ν= 1.53

bλ≦bλp

Permissble stress degree fb: F/ν = 117.7 N/mm^2

Permissible bending stress degree (strong axis)

1) Frange plate <top/bottom face>

Γb :The conversion ratio ＝ b/t・√(F/E)

Γb ＝ 0.83

a) Γb ≦ 1.34	fc ＝ F/1.5	
b) 1.34 ＜ Γb ≦ 2.69	fc ＝ F － 0.248FΓb	
c) 2.69 ＜ Γb	fc ＝ 2.41 F/(Γb2)	
	fb=	120.0 N/mm^2

2)Web plate <side face>

Γd : The conversion ratio ＝ d/t・√(F/E)

Γd ＝ 4.40

a) Γd ≦ 3.29	fb ＝ F/1.5	
b) 3.29 ＜ Γd ≦ 6.57	fb ＝ F － 0.101FΓd	
c) 6.57 ＜ Γd	fb ＝ 14.4 F/($Γd^2$)	
	fb=	100.0 N/mm^2

Therefore, result date is・・・

fbx= 100.0 N/mm^2

fbx= 150.0 N/mm^2

Permissible bending stress degree (weak axis)

1) Frange plate <top/bottom face>

Γb :The conversion ratio ＝ b/t・√(F/E)

Γb= 4.40

a) Γb ≦ 1.34	fc ＝	F/1.5
b) 1.34 ＜ Γb ≦ 2.6 9	fc ＝	F － 0.248FΓd
c) 2.69 ＜ Γb	fc ＝	2.41 F/(Γd2)
	fb=	22.4 N/mm^2

2) Web plate <side face>

Γd : The conversion ratio ＝ d/t・√(F/E)

Γd= 0.83

a) Γd ≦ 3.29	fb ＝	F/1.5
b) 3.29 ＜ Γd ≦ 6.57	fb ＝	F － 0.101FΓd
c) 6.57 ＜ Γd	fb ＝	14.4 F/($Γd^2$)
	fb=	120.0 N/mm^2

Therefore, result date is・・・

fby= 22.4 N/mm^2

fby= 33.6 N/mm^2

Examination of the section of the post

Short period snow load

σb=	76.3 N/mm^2	
σc=N/A=	3.2 N/mm^2	
σb/fb+σc/fc=	0.60 ＜1.0	OK !

Wind blow down

σb=	81.0 N/mm^2	
σc=N/A=	2.4 N/mm^2	
σb/fb+σc/fc=	0.61 ＜1.0	OK !

Wind blow up

σb=	99.9 N/mm^2	
σt=N/A=	3.0 N/mm^2	
σb/fb+σt/ft=	0.68 ＜1.0	OK !

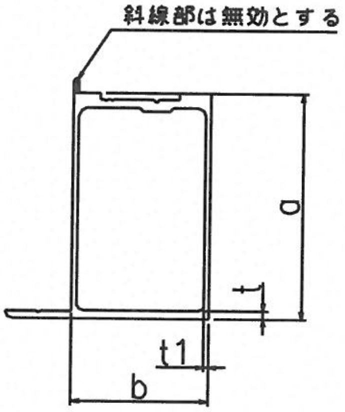
2・lk/i= 118.5 ＜140 OK !

7. Main Frame Bending permissible stress degree

7-1 Bending permissible stress degree

	Permissible stress degree for long period (N／mm2)	Permissible stress for short period(N/m3)
bλ≦bλp	F/ν	Long period x 1.5
bλp<bλ≦bλe	(1.0−0.5((bλ−bλp)/(bλe−bλp)))F/ν	Long period x 1.5
bλe<bλ	(1/bλ²)・(F/ν)	Long period x 1.5

a=	4.60	cm
t=	0.11	cm
t1=	0.09	cm
b=	2.50	cm



Young's modulus factor E= 70000 N/mm^2

Shear elasticity factor of bending materialG= 27000 Nmm

Torsion fixed number of bending material= 3.3 cm^4

Second section moment around weak axis Iy= 2.126 cm^4

Section factor of bending direction Z= 2.512 cm^3

F:Standard strength(N／mm2)= 180 N/mm^2

bλ=√(My/Me)= 0.28

Me=C√((π2EIyGJ)/lb2)= 5684039 Nmm

Bending moment My= 452160 Nmm

C= 1.13

lb= 715 mm

bλp=0.6+0.3(M2/M1)= 0.3

bλe=1/√0.5= 1.41

$\nu = 3/2 + 2(b\lambda / b\lambda e)^2/3$ (its value assumes 2.17 in case more than 2.17)

ν= 1.53

bλ≦bλp

fb= 117.9 N/mm^2

Permissible stress degree at bend parts

1) Frange plate of beam <top/bottom face>

Γb : The conversion ratio = b/t・√(F/E)

Γb = 0.41

a) Γb ≦ 0.438 fb = F/1.5

b) 0.438 < Γb ≦ 0.876 fb = F − 0.760FΓb

c) 0.876 < Γb fb = 0.256 F/(Γb^2)

fb= 120.0 N/mm^2

Γb : The conversion ratio = b/t・√(F/E)

Γb = 1.07

a) Γb ≦ 1.34 fc = F/1.5

b) 1.34 < Γb ≦ 2.69 fc = F − 0.248FΓd

c) 2.69 < Γb fc = 2.41 F/(Γd2)

fb= 120.0 N/mm^2

2) Wave plate of beam <side face>

Γb : The conversion ratio = b/t・√(F/E)

Γd = 2.47

a) Γd ≦ 3.29 fb = F/1.5

b) 3.29 < Γd ≦ 6.57 fb = F − 0.101FΓ

c) 6.57 < Γd fb = 14.4 F/(Γd^2)

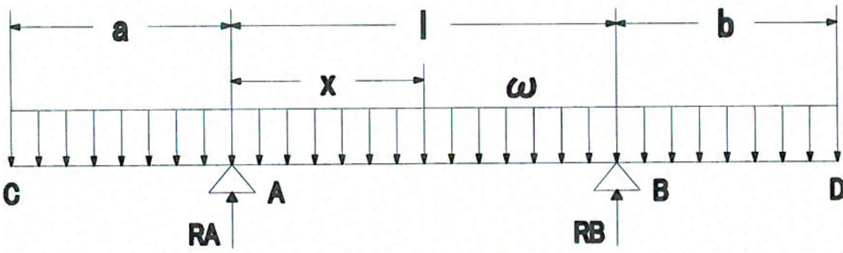
fb= 120.0 N/mm^2

Therefore, result data is…

fb= 117.9 N/mm^2

fb= 176.9 N/mm^2

7-2 Calculation of Main Frame Section



Parts Width＝	0.585 m
Long period ω=	35.1 N/m
Short period load ω=	385.9 N/m
Short period blow up ω=	283.4 N/m
Short period blow down ω=	378.7 N/m
ω=	385.9 N/m
a=	1.1 m
l=	2.9 m
b=	1.1 m
x=	1.45 m
Z=	2.512 cm^3
I=	5.802 cm^4
E=	7000000 N/cm^2

W=Full-Load M=Bend Moment
R=Anti-Power θ=Rotation Angle
Q=Shear Power δ=Bend

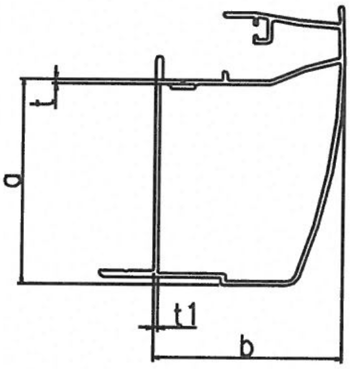
W= w(a+l+b)	=	1939.9 N
RA= $(w(a+l)^2-wb^2)/2l$	=	970.0 N
RB= $(w(b+l)^2-wa^2)/2l$	=	970.0 N
QA= RA-wa	=	559.6 (A,B material)
QB= wb-RB	=	-559.6 (A,B material)
MA= $-(wa^2/2)$	=	-218.2 N･m
σA= MA/Z	=	86.9 N/mm^2
MB= $-(wb^2/2)$	=	-218.2 N･m
σB= MB/Z	=	86.9 N/mm^2
MX= $RA\cdot x-w(a+x)^2/2$	=	187.4 (A,B material)
σX= MX/Z	=	74.6 N/mm^2
σb/fb	=	0.49 ＜1.0 OK !

8. Front frame bending permissible stress degree

8-1 Bending permissible stress degree

	Permissible stress degree for long period (N／mm2)	Permissible stress for short period(N/m3)
bλ≦bλp	F/ν	Long period x 1.5
bλp<bλ≦bλe	(1.0−0.5((bλ−bλp)/(bλe−bλp)))F/ν	Long period x 1.5
bλe<bλ	(1/bλ²)・(F/ν)	Long period x 1.5

a=	4.77	cm
t=	0.10	cm
t1=	0.10	cm
b=	4.20	cm
Young's modulus factor E=	70000	N/mm^2
Shear elasticity factor of bending materialG=	27000	Nmm(アルミ材)
Torsion fixed number of bending material=	8.4	cm^4
Second section moment around weak axis Iy=	6.911	cm^4
Section factor of bending direction Z=	3.805	cm^3
F:Standard strength(N／mm2)=	132	N/mm^2
bλ=√(My/Me)=	0.17	
Me=C√((π2EIyGJ)/lb2)=	16407392	Nmm
Bending moment My=	502260	Nmm
C=	1.13	
lb=	715	mm
bλp=0.6+0.3(M2/M1)=	0.3	
bλe=1/√0.5=	1.41	



$\nu=3/2+2(b\lambda/b\lambda e)^2/3$ (its value assumes 2.17 in case more than 2.17)

ν= 1.51

bλ≦bλp

fb= 87.4 N/mm^2

Permissible stress degree at bend parts

1) Frange plate of beam <top/bottom face>

Γb : The conversion ratio = b/t・√(F/E)

Γb = 1.74

a) Γb ≦ 1.34 fc = F/1.5

b) 1.34 < Γb ≦ 2.69 fc = F − 0.248FΓd

c) 2.69 < Γb fc = 2.41 F/(Γd2)

fb= 75.1 N/mm^2

2) Web plate of beam <side face>

Γd = d/t・√(F/E)

Γd = 1.98

a) Γd ≦ 3.29 fb = F/1.5

b) 3.29 < Γd ≦ 6.57 fb = F − 0.101FΓ

c) 6.57 < Γd fb = 14.4 F/(Γd^2)

fb= 88.0 N/mm^2

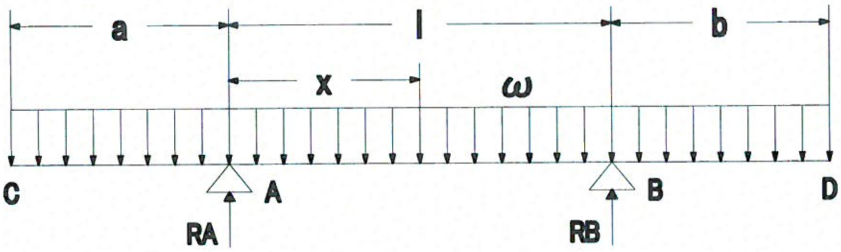
Therefore, result data is…

fb= 75.1 N/mm^2

fb= 112.7 N/mm^2

8-2 Calculation of Front Frame Section

Parts Width= 0.292 m



Long period ω=	17.5 N/m
Short period load ω=	193.0 N/m
Short period blow up ω=	141.7 N/m
Short period blow down ω=	189.4 N/m
ω=	193.0 N/m
a=	1.1 m
l=	2.9 m
b=	1.1 m
x=	1.45 m
Z=	3.805 cm^3
I=	12.495 cm^4
E=	7000000 N/cm^2

W=Full-Load　M=Bend Moment
R=Anti-Power　θ=Rotation Angle
Q=Shear Power　δ=Bend

W= w(a+l+b)	=	970.0 N
RA= $(w(a+l)^2-wb^2)/2l$	=	485.0 N
RB= $(w(b+l)^2-wa^2)/2l$	=	485.0 N
QA= RA-wa	=	279.8 (A,B material)
QB= wb-RB	=	-279.8 (A,B material)
MA= $-(wa^2/2)$	=	-109.1 N･m
σA= MA/Z	=	28.7 N/mm^2
MB= $-(wb^2/2)$	=	-109.1 N･m
σB= MB/Z	=	28.7 N/mm^2
MX= $RA\cdot x-w(a+x)^2/2$	=	93.7 (A,B material)
σX= MX/Z	=	24.6 N/mm^2
σb/fb	=	0.25 ＜1.0　OK !

9. Bending permissible stress degree at rear frame

9-1 Calculation method of effective section

$\Gamma b = b/t \cdot \sqrt{(F/E)} = 0.438$ Therefore…

$b/t = 0.438/\sqrt{(F/E)} = 10.09$

Effective Depth

t2= 1.70 mm

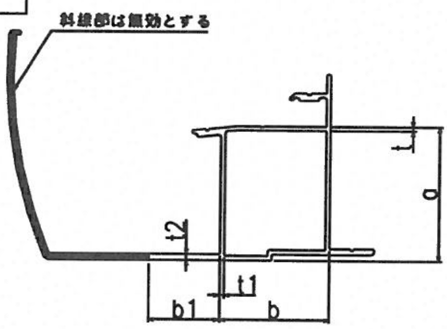
b1= 17.15 mm

9-2. Bending permissible stress degree at rear frame

Bending permissible stress degree

	Permissible stress degree for long period (N／mm2)	Permissible stress for short period(N/m3)
$b\lambda \leqq b\lambda p$	F/ν	Long period x 1.5
$b\lambda p < b\lambda \leqq b\lambda e$	$(1.0-0.5((b\lambda - b\lambda p)/(b\lambda e - b\lambda p)))F/\nu$	Long period x 1.5
$b\lambda e < b\lambda$	$(1/b\lambda^2)\cdot(F/\nu)$	Long period x 1.5

a= 3.82 cm
t= 0.12 cm
t1= 0.12 cm
b= 2.95 cm



Young's modulus factor E= 70000 N/mm^2

Shear elasticity factor of bending materialG＝ 27000 Nmm

Torsion fixed number of bending material＝ 4.0 cm^4

Second section moment around weak axis Iy= 7.702 cm^4

Section factor of bending direction Z= 2.344 cm^3

F:Standard strength(N／mm2)＝ 132 N/mm^2

$b\lambda = \sqrt{(My/Me)} =$ 0.16

$Me = C\sqrt{((\pi^2 EIyGJ)/lb^2)} =$ 12025195 Nmm

Bending moment My= 309408 Nmm

C= 1.13

lb= 715 mm

$b\lambda p = 0.6+0.3(M2/M1) =$ 0.3

$b\lambda e = 1/\sqrt{0.5} =$ 1.41

$\nu = 3/2 + 2(b\lambda / b\lambda e)^2/3$ (its value assumes 2.17 in case more than 2.17)

$\nu =$ 1.51

$b\lambda \leqq b\lambda p$

fb= 87.5 N/mm^2

Permissible stress degree at bend parts

1) Frange plate of beam <top/bottom face>

Γb : The conversion ratio ＝ $b/t \cdot \sqrt{(F/E)}$

$\Gamma b =$ 0.98

a) $\Gamma b \leqq 1.34$ fc ＝ F/1.5

b) $1.34 < \Gamma b \leqq 2.69$ fc ＝ F − 0.248FΓd

c) $2.69 < \Gamma b$ fc ＝ 2.41 F/(Γd2)

fb= 88.0 N/mm^2

2) Web plate of beam <side face>

$\Gamma d = d/t \cdot \sqrt{(F/E)}$

$\Gamma d =$ 1.30

a) $\Gamma d \leqq 3.29$ fb ＝ F/1.5

b) $3.29 < \Gamma d \leqq 6.57$ fb ＝ F − 0.101FΓ

c) $6.57 < \Gamma d$ fb ＝ 14.4 F/(Γd^2)

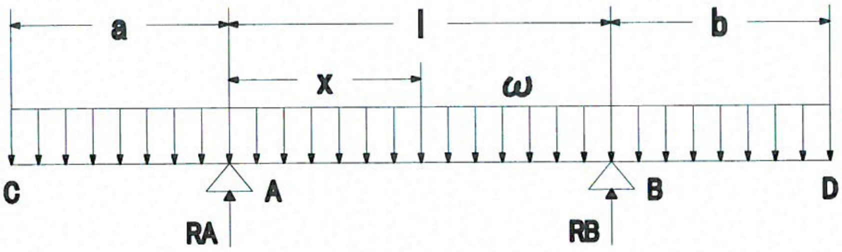
fb= 88.0 N/mm^2

Therefore, result data is…

fb= 87.5 N/mm^2

fb= 131.2 N/mm^2

9-3 Calculation of Rear Frame Section



Parts Width=	0.292 m
Long period ω=	17.5 N/m
Short period load ω=	193.0 N/m
Short period blow up ω=	141.7 N/m
Short period blow down ω=	189.4 N/m
ω=	193.0 N/m
a=	1.1 m
l=	2.9 m
b=	1.1 m
x=	1.45 m
Z=	2.344 cm^3
I=	7.702 cm^4
E=	7000000 N/cm^2

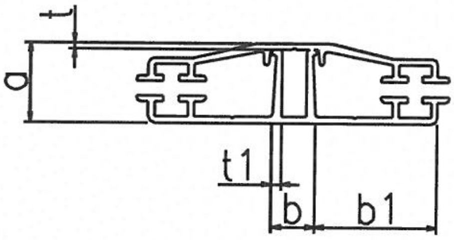
W=Full-Load M=Bend Moment
R=Anti-Power θ=Rotation Angle
Q=Shear Power δ=Bend

W= w(a+l+b)	=	970.0 N
RA= $(w(a+l)^2-wb^2)/2l$	=	485.0 N
RB= $(w(b+l)^2-wa^2)/2l$	=	485.0 N
QA= RA-wa	=	279.8 (A,B material)
QB= wb-RB	=	-279.8 (A,B material)
MA= $-(wa^2/2)$	=	-109.1 N・m
σA= MA/Z	=	46.6 N/mm^2
MB= $-(wb^2/2)$	=	-109.1 N・m
σB= MB/Z	=	46.6 N/mm^2
MX= $RA \cdot x-w(a+x)^2/2$	=	93.7 (A,B material)
σX= MX/Z	=	40.0 N/mm^2
σb/fb	=	0.35 <1.0 OK !

10. Rafter / Roof retainer bending permissible stress degree

10-1 Bending permissible stress degree

a=	1.30 cm
t=	0.10 cm
t1=	0.17 cm
b=	0.72 cm
b1=	1.99 cm
Young's modulus factor E=	70000 N/mm^2
Shear elasticity factor of bending materialG=	27000 Nmm
Second section moment around weak axis Iy=	0.364 cm^4
Section factor of bending direction Z=	0.529 cm^3
F:Standard strength(N／mm2)=	132 N/mm^2



Therefore…

fb= 88.0 N/mm^2

Permissible stress degree at bend parts

Frange plate of beam <top/bottom face>

Γb : The conversion ratio = b/t・√(F/E)

Γb = 0.86

a) Γb ≦ 0.438 fb = F/1.5

b) 0.438 < Γb ≦ 0.876 fb = F − 0.760FΓb

c) 0.876 < Γb fb = 0.256 F/(Γb2)

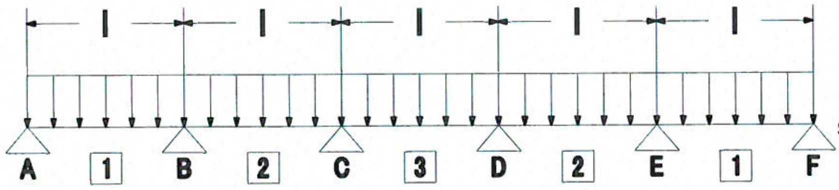
fb= 45.3 N/mm^2

Therefore…

fb= 45.3 N/mm^2

fb= 68.0 N/mm^2

10-2 Calculation of Rafter / Roof retainer section



Parts Width=	0.715	m
l=	0.585	m
Long period ω=	42.9	N/m
Short period load ω=	471.9	N/m
Short period blow up ω=	346.5	N/m
Short period blow down ω=	-463.1	N/m
ω=	471.9	N/m
Z=	0.529	cm^3
I=	0.364	cm^4
E=	7000000	N/cm^2

W=Full-Load　M=Bend Moment
R=Anti-Power　θ=Rotation Angle
Q=Shear Power　δ=Bend

	ωl	=	275.9 N
RA=	0.395 * ωl	=	109.0 N
RB=	1.131 * ωl	=	312.1 N
RC=	0.974 * ωl	=	268.7 N
RD=	0.974 * ωl	=	268.7 N
RE=	1.131 * ωl	=	312.1 N
RF=	0.395 * ωl	=	109.0 N
Rmax=			312.1 N
MB=	$-0.105 * ωl^2$	=	-16.9 N･m
MC=	$-0.079 * ωl^2$	=	-12.7 N･m
MD=	$-0.079 * ωl^2$	=	-12.7 N･m
ME=	$-0.105 * ωl^2$	=	-16.9 N･m
M1=	$0.078 * ωl^2$	=	12.6 N･m
M2=	$0.033 * ωl^2$	=	5.3 N･m
M3=	$0.046 * ωl^2$	=	7.4 N･m
σX=	MX/Z	=	32.0 N/mm^2
	σb/fb	=	0.47 <1.0　OK !

11. Side frame bending permissible stress degree

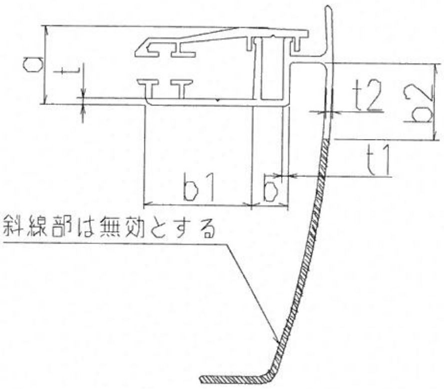
11-1 Calculation method of effective section

$\Gamma b = b/t \cdot \sqrt{(F/E)} = 0.438$ Therefore…

$b/t = 0.438/\sqrt{(F/E)} = 10.09$

Effective Depth

t2=	1.20 mm
b2=	12.10 mm



11-2 Bending permissible stress degree

a=	1.30 cm
t=	0.11 cm
t1=	0.17 cm
b=	0.72 cm
b1=	1.99 cm

Young's modulus factor E=	70000 N/mm^2
ear elasticity factor of bending materialG＝	27000 Nmm
cond section moment around weak axis Iy=	2 cm^4
Section factor of bending direction Z=	0.324 cm^3
F:Standard strength(N／mm2)＝	132 N/mm^2

Therefore…

fb＝ 88.0 N/mm^2

Permissible stress degree at bend parts

Frange plate of beam <top/bottom face>

Γb : The conversion ratio $= b/t \cdot \sqrt{(F/E)}$

$\Gamma b =$ 0.79

a) $\Gamma b \leqq 0.438$ $fb = F/1.5$

b) $0.438 < \Gamma b \leqq 0.876$ $fb = F - 0.760F\Gamma b$

c) $0.876 < \Gamma b$ $fb = 0.256\,F/(\Gamma b2)$

fb= 53.2 N/mm^2

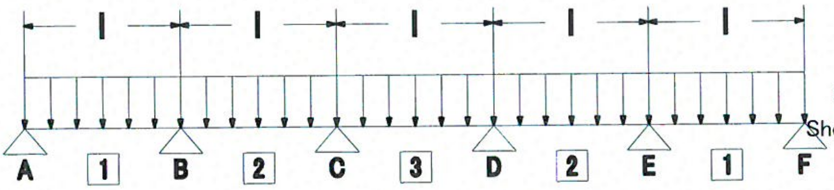
Therefore…

fb= 53.2 N/mm^2

fb= 79.8 N/mm^2

11-3 Calculation of Side frame secton

Parts Width=	0.363 m
l=	0.585 m



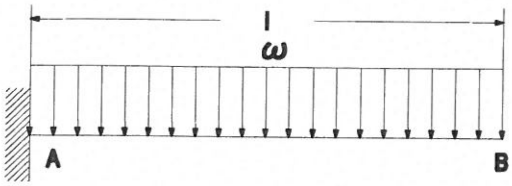
Long period ω=	21.8 N/m
Short period load ω=	239.6 N/m
Short period blow up ω=	175.9 N/m
Short period blow down ω=	-235.1 N/m
ω=	239.6 N/m
Z=	0.324 cm^3
I=	0.399 cm^4
E=	7000000 N/cm^2

W=Full-Load　M=Bend Moment
R=Anti-Power　θ =Rotation Angle
Q=Shear Power　δ =Bend

	ωl	=	140.1 N
RA=	0.395 * ωl	=	55.3 N
RB=	1.131 * ωl	=	158.4 N
RC=	0.974 * ωl	=	136.4 N
RD=	0.974 * ωl	=	136.4 N
RE=	1.131 * ωl	=	158.4 N
RF=	0.395 * ωl	=	55.3 N
Rmax=			158.4 N
MB=	-0.105 * ωl^2	=	-8.6 N・m
MC=	-0.079 * ωl^2	=	-6.5 N・m
MD=	-0.079 * ωl^2	=	-6.5 N・m
ME=	-0.105 * ωl^2	=	-8.6 N・m
M1=	0.078 * ωl^2	=	6.4 N・m
M2=	0.033 * ωl^2	=	2.7 N・m
M3=	0.046 * ωl^2	=	3.8 N・m
σX=	MX/Z	=	26.5 N/mm^2
	σb/fb	=	0.33 <1.0　OK !

12. Corner bracket examination

12-1 Beam load



Load chart

Type			
Vertical load width (m)	Total/post quantity		2.514
l (m)	D-d1-d2		2.925
Load ω (N/m)	Long period load		150.8
	Short period load		1658.9
	Short period blowing up(vertical)		1218.1
	Short period blowing up(vertical)		-1477.3
	Short period blowing down(horizontal)		160.5
	Short period earthquake(vertical)		150.8
	Short period earthquake(horizontal)		45.2
Bending moment M(N・m)	Long period load		645.1
	Short period load		7096.5
	Short period blowing down(vertical)		5211.0
	Short period blowing up(vertical)		-6319.5
	Short period blowing (horizontal)		686.6
	Short period earthquake(vertical)		645.1
	Short period earthquake(horizontal)		193.5
Maximum bending momen (N・m)	maxMx	(long period)	
		(short period)	7096.5
	maxMy	(long period)	
		(short period)	686.6
Second section moment	$Ix(cm^4)$		231.7
	$Iy(cm^4)$		60.7
Section factor	$Zx(cm^3)$		37.4
	$Zy(cm^3)$		18.1
Elasticity factor	$E(N/cm^2)$		21000000
Maximum bending stress degree (N/mm2)	max σx		189.9
	max σy		37.9
Vertical maximum deformation quantity	max δx	(cm)	3.12
	max δx/l	1/	161
Flat maximum deformation quantity	max δy	(cm)	1.15
	max δy/l	1/	437

12-2 Calculation of Corner bracket Section

Material	Second section moment		Section factor	
	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)
GB8064	205.211	65.073	28.119	20.335

fb= 420 N/mm^2

Mx= 7096.5 N・m

My= 686.6 N・m

σbx= 252.4 N/mm^2

σby= 33.8 N/mm^2

σbx/fb= 0.60 <1.0 OK !

σby/fb= 0.08 <1.0 OK !

13. Examination of main frame connecting part

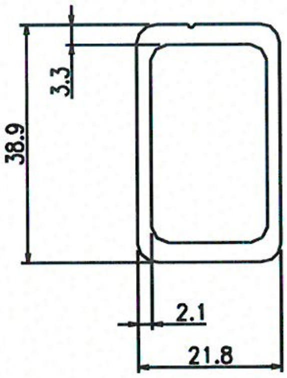
13-1 Calculation of Load

・Anti-Power of rafter

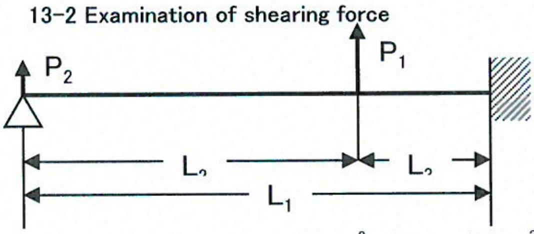
P_1= P1= 312.1 N ←from "Calculation of rafter"

・Anti-Power of connecting rafter

P_2= P2= 156.0 N ←(Anti-Power of rafter)/2



13-2 Examination of shearing force



L_1(m)	1.06
L_2(m)	0.715
L_3(m)	0.35
A(mm^2)	276.8
fs(N/mm^2)	76.2

Q= $(P_1 \cdot L_3^2) \cdot (3L_2+2L_3)/(2L_1^3)+P_2$ より

Q= 200.8 N

τ =Q/A= 0.73 N/mm^2

τ /fs= 0.01 ＜1.0 OK ！

14. Examination of front frame connecting part

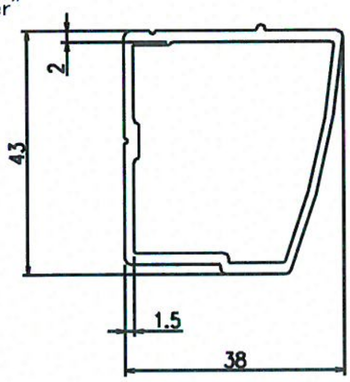
14-1 Calculation of Load

・Anti-Power of rafter

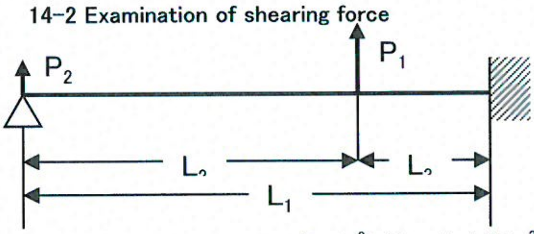
P_1= P1= 109.0 N ←from "Calculation of rafter"

・Anti-Power of connecting rafter

P2= 54.5 N ←(Anti-Power of rafter)/2



14-2 Examination of shearing force



L_1(m)	1.06
L_2(m)	0.715
L_3(m)	0.35
A(mm^2)	261.6
fs(N/mm^2)	76.2

Q= $(P_1 \cdot L_3^2) \cdot (3L_2+2L_3)/(2L_1^3)+P_2$ より

Q= 70.1 N

τ =Q/A= 0.27 N/mm^2

τ /fs= 0.01 ＜1.0 OK ！

15. Examination of gutter connecting part

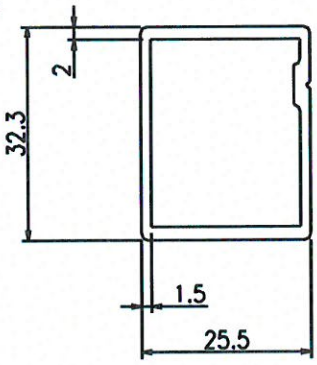
15-1 Calculation of Load

・Anti-Power of rafter

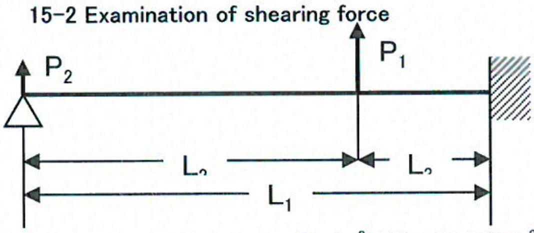
P_1= P1= 109.0 N ←from "Calculation of rafter"

・Anti-Power of connecting rafter

P_2= P2= 54.5 N ←(Anti-Power of rafter)/2



15-2 Examination of shearing force



L_1(m)	1.06
L_2(m)	0.715
L_3(m)	0.35
A(mm^2)	192.1
fs(N/mm^2)	76.2

Q= $(P_1 \cdot L_3^2) \cdot (3L_2+2L_3)/(2L_1^3)+P_2$ より

Q= 70.1 N

τ =Q/A= 0.37 N/mm^2

τ /fs= 0.01 ＜1.0 OK ！

16. Examination of main frame and beam connection

16-1 Examination of screw pull-out force

・Pull-out force/screw

T= 485.0 N

・Stretching permissible stress

$ft = 2.1 \cdot \beta \cdot ((d^2 - d_1^2)/(P \cdot d^4))^{0.5} \cdot t^{1.2} \cdot Ft \cdot 1.5$

= 172.7 N/mm^2

・Effective section

A= 11.2 mm^2

σt= 43.2 N/mm^2

$\sigma t/ft$= 0.25 <1.0 OK !

β	0.6
Screw diameter	5
Core diameter	3.78
Pitch	0.8
t(Thickness)	4.6
Ft(Standard strength)	100

16-2 Examination of Beam bending stress

・Beam top face bending moment

M= 2721.1 N·mm

Z= 58.6 mm^3

σb= 46.5 N/mm^2

$\sigma b/fb$= 0.22 <1.0 OK !

b(Beam depth dimension)	61
t(Thickness)	2.4
a(load point)	18.5

17. Examination of rafter and main frame connection

17-1 Examination of screw pull-out force

・Pull-out force/screw

T= 312.1 N

・Stretching permissible stress

$ft = 2.1 \cdot \beta \cdot ((d^2 - d_1^2)/(P \cdot d^4))^{0.5} \cdot t^{1.2} \cdot Ft \cdot 1.5$

= 93.7 N/mm^2

・Effective section

A= 6.7 mm^2

σt= 46.3 N/mm^2

$\sigma t/ft$= 0.49 <1.0 OK !

β	0.6
Screw diameter	4
Core diameter	2.93
Pitch	0.7
t(Thickness)	2.1
Ft(Standard strength)	100

17-2 Examination of Main frame bending stress

・Main frame top face bending moment

M= 898.7 N·mm

Z= 22.0 mm^3

σb= 40.8 N/mm^2

$\sigma b/fb$= 0.20 <1.0 OK !

b(Beam depth dimension)	25
t(Thickness) center	2.3
a(load point)	10

18. Examination of Roof material

18-1 Examination of Bending volume

Poisson ratio : ν =	0.3	
Distribution Load : P=	0.0116	kgf/cm^2
E: Young's modulus factor =	21000	kgf/cm^2
Thickness : h=	0.18	cm
Short edge a=	70.3	cm
Long edge b=	296.2	cm

Bending volume : Wmax

$A \cdot Wmax^3 + B \cdot Wmax + C = 0$

$A = (4\nu/a^2b^2 + (3-\nu^2) \cdot (1/a^4 + 1/b^4))/h^3$

= 2096.9

$B = (4/3) \cdot (1/a^2 + 1/b^2)^2/h$

= 33.8

$C = -256(1-\nu^2)P/(\pi^6 E h^4)$

= -12701.0

Bending volume : Wmax= 1.82 cm

18-2 Bending stress degree

$\max\sigma x = ((\pi^2 \cdot E \cdot Wmax)/(8 \cdot (1-\nu^2))) \cdot ((2-\nu^2)Wmax+4h)/a^{2+}(\nu(Wmax+4h))/b2)$

= 44.4 kgf/cm^2 < 551 kgf/cm^2 ∴OK !

18-3 Necessary depth of insert

Necessary depth of insert ΔL

ΔL = ΔX x SF + Δl

However, ΔX : The gap volume by a bend

= (lx - b) ／ 2

lx : Arc length while bending

= 2 x sin-1〔(b／2)／r〕x r

r : Radius rate while bending

= (b2+4δ2)／8δ

δ : Bending rate of Polycarbonate = Wmax (cm)

b : Length of short (cm)

Δl : The volume of expansion and contraction at temperature

= K・Δt・b／2

K : Line coefficient of expansion (cm／cm／℃)

Δt : Temperature differency at 50℃

SF : Safety ratio SF=3. 0

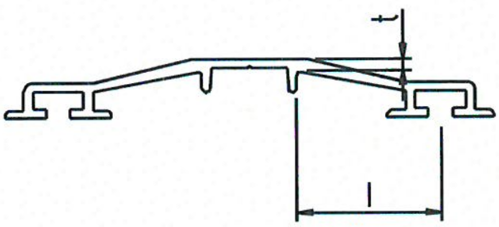
r=	340.4	
lx=	70.43	cm
ΔX=	0.06	cm
K=	0.00007	cm/cm/℃
Δt =	50	℃
SF=	3.0	
Δl=	0.12	cm

Therefore…

ΔL= 0.31 cm depth or more < 1.89 cm ∴OK !

19. Examination of Roof retainer

Rafter pitch=	715	mm
Supporting length l=	15	mm
Material thickness t=	1.2	mm
F: Standard strength=	132	N/mm^2
Blow up load ω=	383.4	N/m
Load P=ωb=	3.834	N
M=P・l=	5.8	Ncm
Section factor $Z=bt^2/6$=	0.002	cm^3
σb=M/Z=	24.0	N/mm^2



$\sigma b/fb$= 0.18 <1.0 OK !

20. Ground Foundation

20-1 Without concrete floor

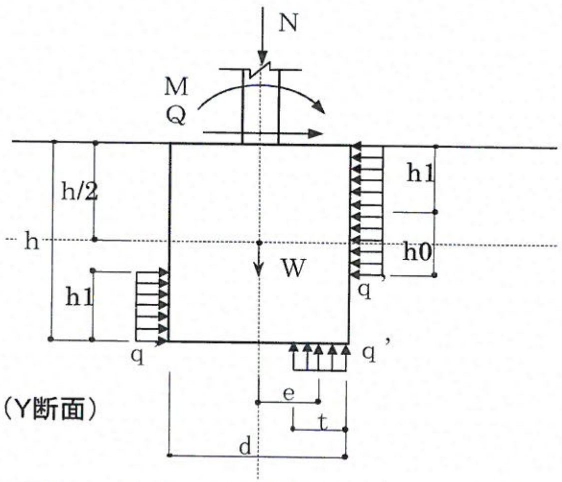
Resistance moment

M_R=(N+W)×e+q's×b×h_1×(h_1+h_0)

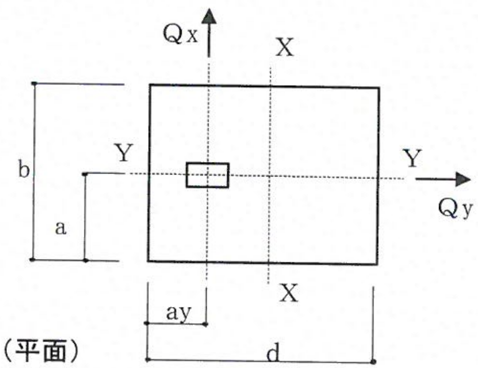
Resistance moment

M=M'+Q*(h/2)−N x (d/2−a)

Base Foundation	
Lateral Pressure	0.5
b=	0.90 m
d=	1.20 m
h=	0.55 m
ay=	0.30 m
ax=	0.45 m
Endurance strength of ground Fe=	100 KN/m²
Short Term Permissible Endurance strength of ground q=	200 KN/m²
No line concrete Volume weight	22.5 KN/m³



(Y断面)



(平面)

	Spindle Force(N)	Shear power(N)		Moment(Nm)		Foundation size(m)				Base Weight	Endurance strength of ground	Lateral Pressure
	N	Qx	Qy	M'x	M'y	b	d	h	a	W(N)	q'(kN/m2)	's(kN/m2)=0.5
Long period load	547.2	0.0	0.0	612.5	0.0	0.90	1.20	0.55	0.30	13,365	100	50.0
Short period load	5071.5	0.0	0.0	6737.2	0.0	0.90	1.20	0.55	0.30	13,365	200	100.0
Short term earthquake X	547.2	135.7	0.0	612.5	305.4	0.90	1.20	0.55	0.30	13,365	200	100.0
Short term earthquake Y	547.2	0.0	135.7	917.9	0.0	0.90	1.20	0.55	0.30	13,365	200	100.0
Short period blow down + Holizontal	3749.2	637.4	0.0	4947.2	1434.2	0.90	1.20	0.55	0.30	13,365	200	100.0
Short period blow down + Holizontal	3749.2	0.0	980.0	7152.2	0.0	0.90	1.20	0.55	0.30	13,365	200	100.0
Short period blow up+Holizontal X	−4789.4	637.4	0.0	−6612.0	1434.2	0.90	1.20	0.55	0.30	13,365	200	100.0
Short period blow up+Holizontal Y	−4789.4	0.0	−980.0	−8817.0	0.0	0.90	1.20	0.55	0.30	13,365	200	100.0

■Examination of subsidence (short period snow)

subsidence load		Endurance strength of ground	
N+W (N)	<	b×d×q (N)	
18437		216000	∴OK !

■Examination of uplift (short period blow up)

uplift load		Base weight	
N (N)	<	b×d×h×γ(N)	
4789		13365	∴OK !

	X direction							
	t(m)	e(m)	h0(m)	h1(m)	Resistance MRx	Fall Mx		JUDGMENT
	(N+W)/(b×q')	(d−t)/2	Qy/(b×q's)	(h−h0)/2	MRx(N·m)	Mx(N·m)	Mx/MRx	MR≧M
Long period load	0.155	0.523	0.000	0.275	10,675	448.3	0.042	<1.0 OK !
Short period load	0.102	0.549	0.000	0.275	16,924	5215.8	0.308	<1.0 OK !
Short term earthquake X	0.077	0.561	0.000	0.275	14,616	448.3	0.031	<1.0 OK !
Short term earthquake Y	0.077	0.561	0.002	0.274	14,616	791.0	0.054	<1.0 OK !
Short period blow down + Holizontal X	0.095	0.552	0.000	0.275	16,261	3822.4	0.235	<1.0 OK !
Short period blow down + Holizontal Y	0.095	0.552	0.011	0.270	16,259	6296.9	0.387	<1.0 OK !
Short period blow up+Holizontal X	0.048	0.576	0.000	0.275	11,747	−5175.2	0.441	<1.0 OK !
Short period blow up+Holizontal Y	0.048	0.576	0.011	0.270	11,745	−7649.7	0.651	<1.0 OK !

	Y direction							
	t(m)	e(m)	h0(m)	h1(m)	Resistance MRx	Fall Mx		JUDGMENT
	(N+W)/(d×q')	(b−t)/2	Qx/(d×q's)	(h−h0)/2	MRy(N·m)	My(N·m)	My/Mry	MR≧M
Short term earthquake X	0.058	0.421	0.001	0.274	14,932	342.7	0.023	<1.0 OK !
Short period blow down + Holizontal X	0.071	0.414	0.005	0.272	16,165	1609.5	0.100	<1.0 OK !
Short period blow up+Holizontal X	0.036	0.432	0.005	0.272	12,780	1609.5	0.126	<1.0 OK !

21-1 With concrete floor

Resistance moment

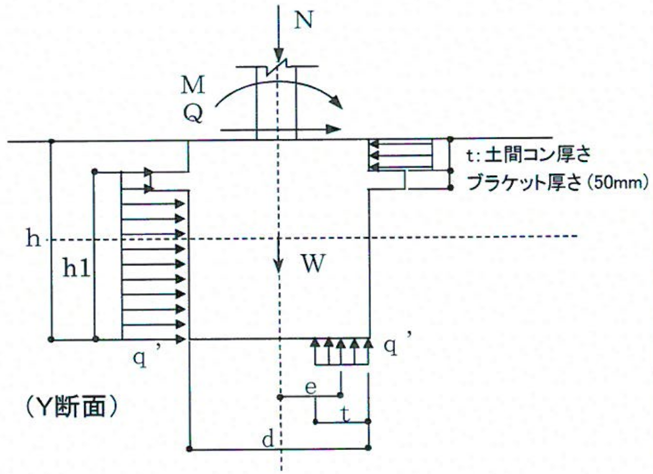
M_R=(N+W)×e+q's×b×h_1×h_1/2

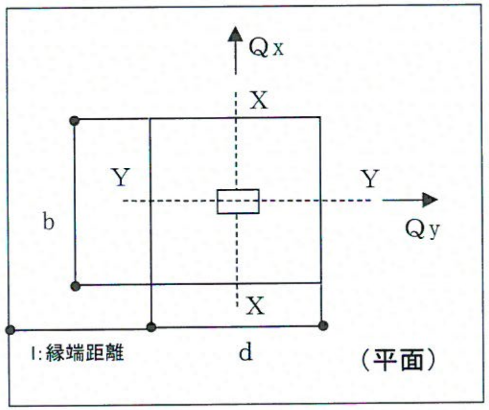
Fall moment

M=M'+Q*(h/2)

Base Foundation

Lateral Pressure	**0.5**
b=	0.60 m
d=	0.45 m
h=	0.55 m
h_1=	0.45 m
l=	0.35 m
Concrete floor thickness t=	0.10 m
Endurance strength of ground Fe=	50 KN/m^2
Short Term Permissible Endurance strength of ground q=	100 KN/m^2
No line concrete Volume weight γ=	22.5 KN/m^3
Concrete standard strength Fc=	15000 KN/m^3





	Spindle Force(N)	Shear power(N)		Moment(Nm)		Foundation size(m)					Base Weight	Endurance strength of ground	Lateral Pressure
	N	Qx	Qy	M'x	M'y	b	d	h	nd part lengt	oor thicknes	W(N)	q'(kN/m2)	's(kN/m2)=0.5c
Long period load	547.2	0.0	0.0	612.5	0.0	0.60	0.45	0.55	0.35	0.10	3,341	50	25.0
Short period load	5071.5	0.0	0.0	6737.2	0.0	0.60	0.45	0.55	0.35	0.10	3,341	100	50.0
Short term earthquake X	547.2	135.7	0.0	612.5	305.4	0.60	0.45	0.55	0.35	0.10	3,341	100	50.0
Short term earthquake Y	547.2	0.0	135.7	917.9	0.0	0.60	0.45	0.55	0.35	0.10	3,341	100	50.0
Short period blow down + Holizontal X	3749.2	637.4	0.0	4947.2	1434.2	0.60	0.45	0.55	0.35	0.10	3,341	100	50.0
Short period blow down + Holizontal Y	3749.2	0.0	980.0	7152.2	0.0	0.60	0.45	0.55	0.35	0.10	3,341	100	50.0
Short period blow up+Holizontal X	-4789.4	637.4	0.0	-6612.0	1434.2	0.60	0.45	0.55	0.35	0.10	3,341	100	50.0
Short period blow up+Holizontal Y	-4789.4	0.0	-980.0	-8817.0	0.0	0.60	0.45	0.55	0.35	0.10	3,341	100	50.0

■Examination of subsidence (short period snow)

subsidence load		Endurance strength of ground
N+W (N)	<	b×d×q (N)
8413		27000

∴OK !

■Concrete floor panchingshere (short term wind blow up)

share force		permissible share force
Q (N)	<	1.5×fs×t×0.9l×2(N)
67108		94500

∴OK !

■Concrete floor bearing capacity (short term wind blow up)

share force		bearing capacity
Q (N)	<	fc×b×0.875t/2(N)
67108		262500

∴OK !

	X direction							
	Vertical load	t(m)	e(m)	Resistance MRx	Fall Mx		JUDGMENT	
	N+W(N)	(N+W)/(b×q')	(d-t)/2	MRx(N・m)	Mx(N・m)	Mx/MRx	MR≧M	
Long period load	3888.5	0.130	0.160	2,142	153.1	0.071	<1.0	OK !
Short period load	8412.8	0.140	0.155	4,341	1684.3	0.388	<1.0	OK !
Short term earthquake X	3888.5	0.065	0.193	3,786	153.1	0.040	<1.0	OK !
Short term earthquake Y	3888.5	0.065	0.193	3,786	232.9	0.061	<1.0	OK !
Short period blow down + Holizontal X	7090.5	0.118	0.166	4,214	1236.8	0.294	<1.0	OK !
Short period blow down + Holizontal Y	7090.5	0.118	0.166	4,214	1812.5	0.430	<1.0	OK !
Short period blow up+Holizontal X	0.0	0.000	0.225	3,038	-1653.0	0.544	<1.0	OK !
Short period blow up+Holizontal Y	0.0	0.000	0.225	3,038	-2228.8	0.734	<1.0	OK !

	Y direction							
	Vertical load	t(m)	e(m)	Resistance MRx	Fall Mx		JUDGMENT	
	N+W(N)	(N+W)/(b×q')	(d-t)/2	MRx(N・m)	Mx(N・m)	Mx/MRx	MR≧M	
Short term earthquake X	3888.5	0.086	0.257	3,277	79.7	0.024	<1.0	OK !
Short period blow down + Holizontal X	7090.5	0.158	0.221	3,847	374.5	0.097	<1.0	OK !
Short period blow up+Holizontal X	0.0	0.000	0.300	2,278	374.5	0.164	<1.0	OK !

STATIC REPORT

PJR－series

5033-H23

2016. 01. 26

SankyoTateyama,Inc.

1. Material and Evaluation

①Post

Materi: A6063S-T6(SS)

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N/mm2
DE8388	13.90	563.62	173.23	75.15	36.47	70000	3.53	180

Material evaluation (without support and side panel Vex=38m/s)

Snow for short period

$\sigma b/fb+\sigma c/fc=$ 0.61 <1.0 OK !

Wind blow down

$\sigma b/fb+\sigma c/fc=$ 0.60 <1.0 OK !

Wind blow up

$\sigma b/fb+\sigma t/ft=$ 0.68 <1.0 OK !

2・lk/i= 115.6 <140 OK !

②Beam

Materi: A6063S-T6(SS)

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N/mm2
DE8393	9.06	231.70	60.75	37.37	18.13	70000	2.59	180

Material evaluation (without support and side panel Vex=38m/s)

Snow for short period

$\sigma b/fb=$ 0.72 <1.0 OK !

Wind blow down

$\sigma bx/fbx=$ 0.53 <1.0 OK !

Wind blow up

$\sigma bx/fbx=$ 0.71 <1.0 OK !

③Main frame

Materi: A6063S-T6(SS)

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N/mm2
DE8578有	1.64	5.33	2.07	2.27	0.91	70000	1.13	180

Material evaluation

$\sigma b/fb=$ 0.29 <1.0 OK !

④Front frame

Materi: A6063S-T5

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N/mm2
DE8401	2.55	12.50	6.91	3.81	2.20	70000	1.65	132

Material evaluation

$\sigma b/fb=$ 0.14 <1.0 OK !

⑤Rear frame

Materi: A6063S-T5

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N/mm2
DE8404有	2.55	7.70	5.90	2.34	1.82	70000	1.52	132

Material evaluation

$\sigma b/fb=$ 0.19 <1.0 OK !

⑥Rafter

Materi. A6063S-T5

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N／mm2
DE8654+DE8666	1.88	0.36	3.75	0.53	1.48	70000	1.41	132

Material evaluation

σb/fb= 0.57 ＜1.0 OK !

⑦Side frame

Materi. A6063S-T5

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N／mm2
DE8683+DE8412	1.65	0.40	2.00	0.32	0.93	70000	1.10	132

Material evaluation

σb/fb= 0.40 ＜1.0 OK !

⑧Corner bracket

Materi. SPFH590

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N／mm2
GB8064	8.58	205.21	65.07	28.12	20.34	210000	2.75	420

Material evaluation (without support and side panel Vex＝38m/s)

σbx/fb= 0.52 ＜1.0 OK !

σby/fb= 0.10 ＜1.0 OK !

⑨Main frame connecting parts

Materi. A6063S-T5

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N／mm2
GB8086	2.77	5.59	1.85	2.87	1.69	70000	0.82	132

Material evaluation

τ /fs= 0.01 ＜1.0 OK !

⑩Front frame connecting parts

Materi. A6063S-T5

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N／mm2
GB8084	2.62	6.94	4.75	2.95	2.26	70000	1.35	132

Material evaluation

τ /fs= 0.01 ＜1.0 OK !

⑪Rear frame connecting parts

Materi. A6063S-T5

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N／mm2
GB8085	1.92	2.92	1.83	1.78	1.40	70000	0.98	132

Material evaluation

τ /fs= 0.01 ＜1.0 OK !

⑫**Roof material**

Materi: polycarbonate

Material performance

Material	Thickness	Length(short part)	Length(long part)	Inserting	Poisson ratio	Elasticity factor	F value
	cm	cm	cm	cm	ν	kgf/cm2	kgf/cm2
GB4107	0.18	70.3	326.4	1.89	0.3	21000	551

Material evaluation

Bending volume : Wmax＝ 1.82 cm

max σx＝ 44.50 kgf/cm^2 ＜ 551.0 kgf/cm^2 ∴OK !

Necessary depth of insert ΔL 0.31 cm depth or more ＜ 1.89 cm ∴OK !

⑬**Roof retainer**

Materi: A6063S-T5

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N／mm2
DE8411	0.79	0.03	1.84	0.08	0.72	70000	1.52	132

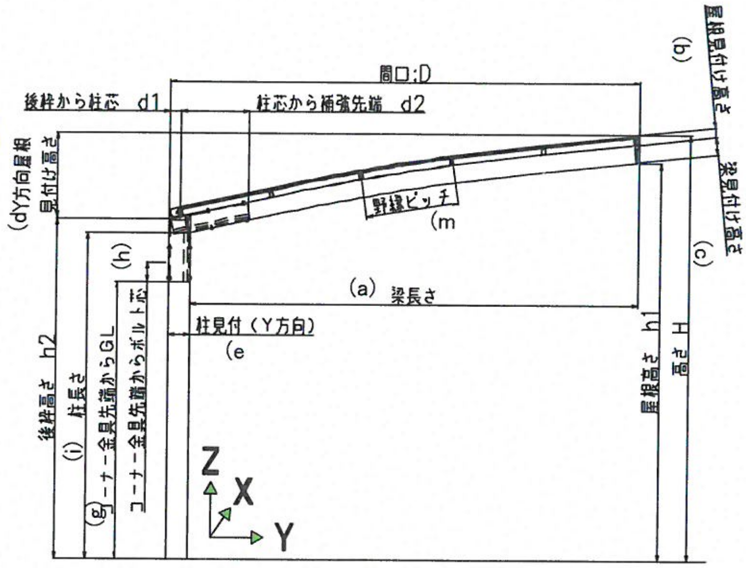
Material evaluation

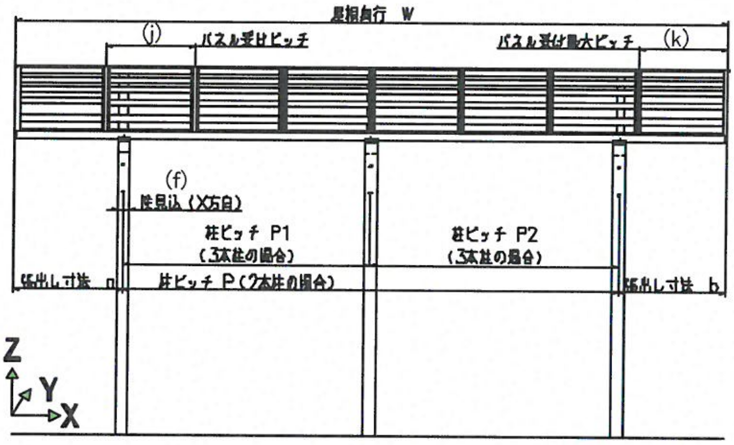
σb/fb= 0.18 ＜1.0 OK !

2. Carport detail

type 5033-H23

Roof projection A=	16.59 m^2
Burden projection per post=	5.53 m^2
Depth : D=	3.300 m
Roof length : W=	5.027 m
from rear frame to post core d1=	0.075 m
from post core to reinforcing end d2=	0.484 m
(a)Beam length=	3.150 m
Overhang length a=	0.739 m
post pitch : P1=	1.775 m
post pitch : P2=	1.775 m
Overhang length b=	0.739 m
(b) Roof part thickness	0.065 m
(c) Beam thickness	0.124 m
(d) Y direction roof part height=	0.588 m
(e) Post dimension(Y direction)=	0.150 m
(f) Post dimension(X direction)=	0.095 m
Overall Height(GL to Roof end) H=	2.936 m
Overall Height(GL to Beam) h1=	2.746 m
Overall Height(GL to Rear frame) h2=	2.348 m
(g) from the end of corner bracket to GL=	1.910 m
(h) from the end of corner bracket to the center of bolts=	0.130 m
(i) Post length=	2.250 m
Post quantity=	3
(j) Rafter pitch=	0.715 m
(k) Rafter maximum span=	0.726 m
(m) Main frame pitch=	0.645 m





3. Load design

①Vertical over load (G)

Part Weight

Roof	60.0 N/m^2
Post	36.8 N/m

②Snow over load

Post quantity	Snow area	Snow quantity	Unit weight	Short period snow period
2 posts type	General area	20 cm	30 $N/m^2/cm$	600 N/m^2

③ Wind blowing load(Vex=38m/s)

・For design of structure frame

Speed pressure $q=0.6E(Vex\cdot y)^2=$	708 N/m^2
Standard wind speedVex=	38 m/s
$E=Er^2Gf=$	1.194
$Er=1.7(Zb/Z_G)^\alpha=$	0.691
Ground surface Div.	Ⅲ
Gust influence factor Gf=	2.5
Zb=	5
$Z_G=$	450
$\alpha=$	0.2
Installation period factor y=	0.827

・For roof material design

Average speed pressure $q'=0.6Er2(Vex\cdot y)^2=$	283 N/m^2

④Earthquake power

Earthquake power Qi=Z・Rt・Ai・Co・Wi

Area factorZ=	1.0
Vibration feature Rt=	1.0
Coat shear power distribution factorAi=	1.0
Standard shear power factorC_o =	0.3

4. Preparing calculation

4-1 Carport load (For earthquake power calculation)

Roof	332	N
Post	83	N
Wi=	415	N

Earthquake power Qi=Z･Rt･Ai･Co･Wi= 124.4 N

4-2 Wind pressure power calculation (Maximum wind power pressure for 1 post)

･For design of structure frame

Wind factor		
Independent shed	10 °	
C=	0.60	(+pressure)
	-1.00	(-pressure)
	1.2	(Post flat power, side panel)

Wind pressureW=q C=	425 N/m^2	(Wind blow down)
	-708 N/m^2	(Wind blow up)
	849 N/m^2	(Flat)

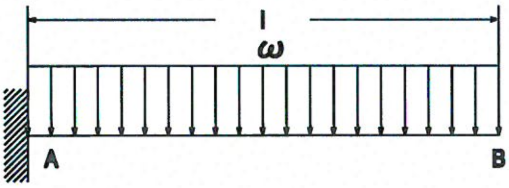
･Roof material design

Peak with factor calculation process Gpe=	3.1 (+pressure)				
	3.0 (-pressure: panel center part)				
	4.0 (-pressure: panel surrounding part)				
Peak wind factor Cf=	3.1	x	0.60	=	1.86
	3.0	x	-1.00	=	-3.00
	4.0	x	-1.00	=	-4.00

Wind pressure W=q' Cf=	527 N/m^2	(Wind blow down)
	-849 N/m^2	(Wind blow up)
	-1132 N/m^2	(Wind blow up)

5. Beam material examination

5-1 Beam load(without support Vex=38m/s)



Load chart

Type			
Vertical load width (m)			1.775
l (m)	D-d1-d2		2.741
Load ω(N/m)	Long period load		106.5
	Short period load		1171.5
	Short period blowing down(vertical)		860.2
	Short period blowing up(vertical)		-1149.7
	Short period blowing down(horizontal)		133.8
	Short period earthquake(vertical)		106.5
	Short period earthquake(horizontal)		32.0
Bending moment M(N・m)	Long period load		400.1
	Short period load		4400.8
	Short period blowing down(vertical)		3231.5
	Short period blowing up(vertical)		-4319.0
	Short period blowing (horizontal)		502.5
	Short period earthquake(vertical)		400.1
	Short period earthquake(horizontal)		120.0
Maximum bending mom (N・m)	maxMx	(long period)	
		(short period)	4400.8
	maxMy	(long period)	
		(short period)	502.5
Second section mome	Ix(cm^4)		231.7
	Iy(cm^4)		60.7
Section factor	Zx(cm^3)		37.4
	Zy(cm^3)		18.1
Elasticity factor	E(N/cm^2)		7000000
Maximum bending stre (N/mm2)	max σx		117.8
	max σy		27.7
Vertical maximum defo	max δx (cm)		5.10
	max δx/l	1/	99
Flat maximum deforma	max δy (cm)		2.22
	max δy/l	1/	226

5-2 Beam permissible stress degree

Bending permissible stress degree

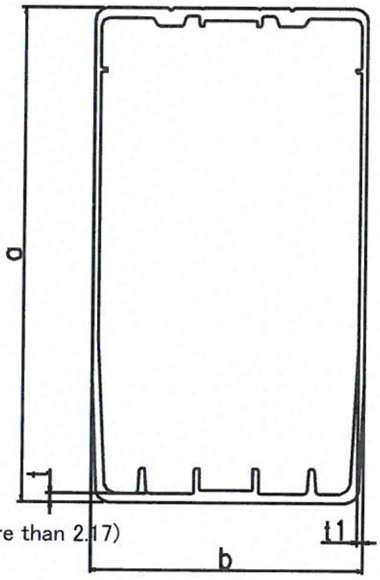
	Permissible stress degree for long period (N／mm2)	Permissible stress for short period(N/m3)
$b\lambda \leqq b\lambda p$	F/ν	Long period x 1.5
$b\lambda p < b\lambda \leqq b\lambda e$	$(1.0-0.5((b\lambda - b\lambda p)/(b\lambda e - b\lambda p)))F/\nu$	Long period x 1.5
$b\lambda e < b\lambda$	$(1/b\lambda^2)\cdot(F/\nu)$	Long period x 1.5

a=	12.40	cm
t=	0.38	cm
t1=	0.15	cm
b=	6.70	cm
Young's modulus factor E=	70000	N/mm^2
Shear elasticity factor of bending materialG=	27000	Nmm
Torsion fixed number of bending material=	127.3	cm^4
Second section moment around weak axis Iy=	60.745	cm^4
Section factor of bending direction Z=	37.37	cm^3
F:Standard strength(N／mm2)=	180	N/mm^2
$b\lambda=\sqrt{(My/Me)}$=	0.14	
$Me=C\sqrt{((\pi^2 EIyGJ)/lb^2)}$=	325832829	Nmm
Bending moment My=	6726600	Nmm
$C=1.75+1.05(M2/M1)+0.3(M2/M1)^2$=	1.75	
M2=	0	Nm
M1=	4319	Nm
M2/M1=	0	
lb=	645.1	mm
$b\lambda p=0.6+0.3(M2/M1)$=	0.6	
$b\lambda e=1/\sqrt{0.5}$=	1.41	

$\nu=3/2+2(b\lambda/b\lambda e)^2/3$ (its value assumes 2.17 in case more than 2.17)

ν = 1.51

$b\lambda \leqq b\lambda p$



Permissible stress degree fb: F/ν = 119.5 N/mm^2

Permissible stress degree at bend parts (strong axis)

1) Frange plate of beam <top/bottom face>

Γb : The conversion ratio = $b/t\cdot\sqrt{(F/E)}$

Γb = 0.85

a) $\Gamma b \leqq 1.34$ fb = F/1.5

b) $1.34 < \Gamma b \leqq 2.69$ fb = F − 0.248FΓb

c) $2.69 < \Gamma b$ fb = $2.41\ F/(\Gamma b^2)$

fb= 120.0 N/mm^2

2) Web plate of beam <side face>

Γd : The conversion ratio = $d/t\cdot\sqrt{(F/E)}$

Γd = 3.94

a) $\Gamma d \leqq 3.29$ fb = F/1.5

b) $3.29 < \Gamma d \leqq 6.57$ fb = F − 0.101FΓ

c) $6.57 < \Gamma d$ fb = $14.4\ F/(\Gamma d^2)$

fb= 108.5 N/mm^2

Therefore, result data is…

fbx= 108.5 N/mm^2

fbx= 162.7 N/mm^2

Permissible stress degree at bend parts (weak axis)

1) Frange plate of beam <top/bottom face>

Γb : = b/t・√(F/E)

	Γb =	3.94
a) Γb ≦ 1.34	fb = F/1.5	
b) 1.34 < Γb ≦ 2.69	fb = F − 0.248FΓb	
c) 2.69 < Γb	fb = 2.41 F/(Γb^2)	
	fb=	28.0 N/mm^2

2) Web plate of beam <side face>

Γd :The conversion ratio = d/t・√(F/E)

	Γd =	0.85
a) Γd ≦ 3.29	fb = F/1.5	
b) 3.29 < Γd ≦ 6.57	fb = F − 0.101FΓ	
c) 6.57 < Γd	fb = 14.4 F/(Γd^2)	
	fb=	120.0 N/mm^2

Therefore, result data is…

fby=	28.0 N/mm^2
fby=	**42.0 N/mm^2**

Section of the Beam examination

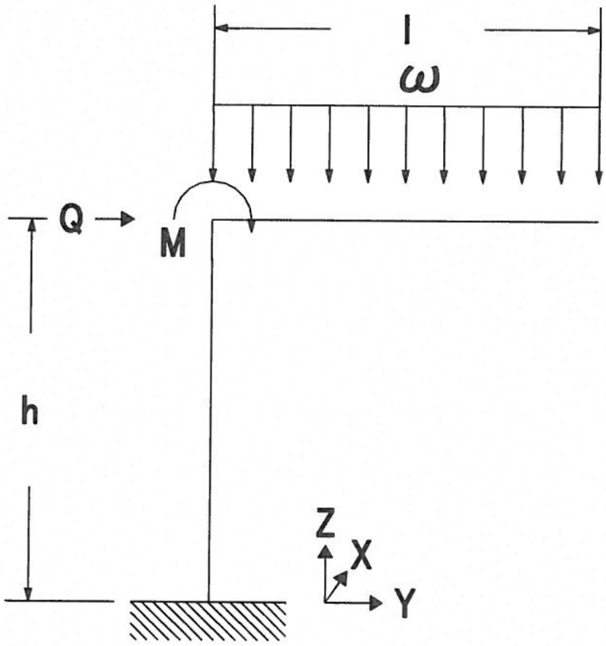
Snow for short period			
M=	4400.8 N・m		
σb=	117.8 N/mm^2		
σb/fb=	0.72	<1.0	OK !
Wind blow down			
M=	3231.5 N・m		
σbx=	86.5 N/mm^2		
σbx/fbx=	0.53	<1.0	OK !
Wind blow up			
M=	-4319.0 N・m		
σbx=	115.6 N/mm^2		
σbx/fbx=	0.71	<1.0	OK !
Wind blow horizontal			
M=	502.5		
σby=	27.7		
σby/fby=	0.66	<1.0	OK !

6. Post material examination

6-1 Post load

Load chart

Type		
Vertical load width (m)		1.775
l (m)	D-d1	3.150
Load ω (N/m)	Long period load	106.5
	Short period snow load	1171.5
	Short period blowing down(vertical	860.2
	Short period blowing up(vertical)	-1149.7
	Short period earthquake(vertical)	106.5
Axial force by vertical load N(N)	Long period load	434.2
	Short period snow load	3948.7
	Short period blowing down(vertical	2921.5
	Short period blowing up(vertical)	-3711.4
	Short period earthquake(vertical)	434.2
Flat load Q(N)	Short period wind X	677.5
	Short period wind Y	738.0
	Short period earthquakeX、Y	99.5
Bending moment M(N・m)	Long period load	528.4
	Short period snow load	5812.1
	Short period blowing down(vertical	4267.9
	Short period blowing up(vertical)	-5704.1
	Short period earthquake(vertical)	528.4
Bending moment by vertical and flat load Mx(N・m)	Short period blowing down(vertical)+WindY	5928.4
	Short period blowing up(vertical)+WindY	-7364.7
	Short period earthquake(vertical) + Earthquak	752.3
Bending moment by flat load My(N・m)	Short period windX	1524.5
	Short period earthquakeX	224.0
Maximum bending moment(N・m)	maxMx (long period)	
	(short period)	7364.7
	maxMy (short period wind)	1524.5
	(short period earthqua	224.0
Second section moment	Ix(cm^4)	563.623
	Iy(cm^4)	173.23
Section factor	Zx(cm^3)	75.15
	Zy(cm^3)	36.47
Max. bending stress deg. σx(N/mm2)	Long period load	7.03
	Short period snow load	77.34
	Short period blowing down(vertical	56.79
	Short period blowing up(vertical)	-75.90
	Short period earthquake(vertical)	7.03
	Short period blowing up(vertical)+WindY	78.89
	Short period blowing down(vertical)+WindY	-98.00
	Short period earthquake(vertical) + Earthquak	10.01
max σx(N/mm2) (uniaxial bending)	Long period	7.03
	Short period(Y direction Vertical load)	98.00
Bending stress degree σy(N/mm2)	Short period windX	41.80
	Short period earthquakeX	6.14



6-2 Post permissible stress degree

Permissible pressure stress degree

	Permissible stress degree for long period (N/mm2)	For short period(N/m3)
$c\lambda \leqq c\lambda p$	F/ν	Long period x 1.5
$c\lambda p < c\lambda \leqq c\lambda e$	$(1.0-0.5((c\lambda - c\lambda p)/(c\lambda e - c\lambda p)))F/\nu$	Long period x 1.5
$c\lambda e < c\lambda$	$(1/c\lambda^2)\cdot(F/\nu)$	Long period x 1.5

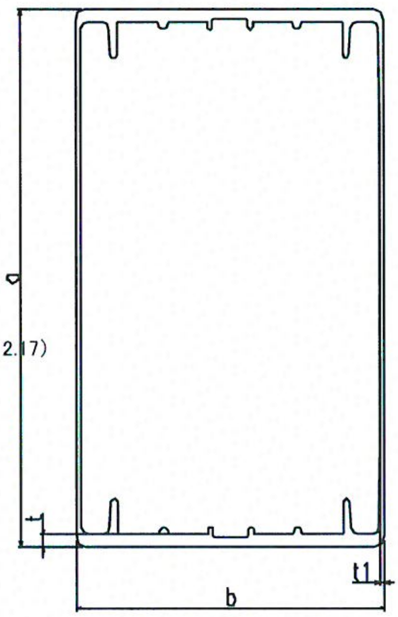
a=	15.00	cm
t=	0.44	cm
t1=	0.16	cm
b=	9.50	cm
$c\lambda=(lk/i)\sqrt{}(F/\pi^2E)$=	1.9	
lk: Buckling length (cm) =	407.96	cm
Standard strength F (N/mm2) =	180	N/mm^2
E: Young's modulus factor (N/mm2) =	70000	N/mm^2
$c\lambda p$=	0.2	
$c\lambda e=1/\sqrt{}0.5$=	1.41	

$\nu=3/2+2(c\lambda/c\lambda e)2/3$ (its value assumes 2.17 in case more than 2.17)

ν =	2.17	
H=	203.98	cm
Section second radius i (cm) =	3.53	cm

$c\lambda e < c\lambda$

fc= 36.6 N/mm^2



Permissible stress degree at bend parts

1) Frange plate of beam <top/bottom face>

Γb : = $b/t \cdot \sqrt{}(F/E)$

Γb = 1.06

a) $\Gamma b \leqq 1.34$ fb = F/1.5

b) $1.34 < \Gamma b \leqq 2.69$ fb = F − 0.248FΓb

c) $2.69 < \Gamma b$ fb = 2.41 F/(Γb^2)

fc= 120.0 N/mm^2

2) Web plate of beam <side face>

Γd : = $d/t \cdot \sqrt{}(F/E)$

Γd = 4.48

a) $\Gamma d \leqq 1.34$ fb = F/1.5

b) $1.34 < \Gamma d \leqq 2.69$ fb = F − 0.248FΓd

c) $2.69 < \Gamma d$ fb = 2.41 F/(Γd^2)

fc= 21.7 N/mm^2

Therefore, result date is・・・

fc= 21.7 N/mm^2

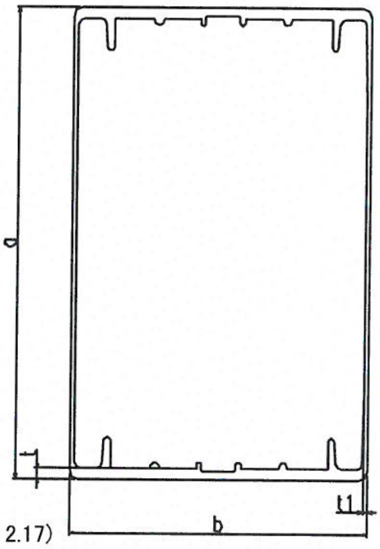
fc= 32.5 N/mm^2

6–3 Permissible stress degree at bend parts

Permissible bending stress degree

	Permissible stress degree for long period (N／mm2)	For short period(N/m3)
bλ≦bλp	F/ν	Long period x 1.5
bλp<bλ≦bλe	(1.0−0.5((bλ−bλp)/(bλe−bλp)))F/ν	Long period x 1.5
bλe<bλ	(1/bλ²)・(F/ν)	Long period x 1.5

a=	15.00	cm
t=	0.44	cm
t1=	0.16	cm
b=	9.50	cm
Young's modulus factor E=	70000	N/mm^2
Shear elasticity factor of bending material G=	27000	Nmm
Torsion fixed number of bending material=	329.6	cm^4
Second section moment around weak axis Iy=	173.233	cm^4
Section factor of bending direction Z=	75.15	cm^3
F: Standard strength (N／mm2) =	180	N/mm^2
bλ=√(My/Me)=	0.28	
$Me=C\sqrt{((\pi^2 EIyGJ)/lb^2)}$=	170876462	Nmm
Bending moment My=	13527000	Nmm
$C=1.75+1.05(M2/M1)+0.3(M2/M1)^2$=	1	
M2=	−5704.1	Nm
M1=	5704.1	Nm
M2/M1=	−1	
lb=	1909.8	mm
bλp=0.6+0.3(M2/M1)=	0.3	
bλe=1/√0.5=	1.41	



$\nu=3/2+2(b\lambda/b\lambda e)^2/3$ (its value assumes 2.17 in case more than 2.17)

ν = 1.53

bλ≦bλp

Permissble stress degree fb: F／ν = 117.9 N/mm^2

Permissible bending stress degree (strong axis)

1) Frange plate <top/bottom face>

Γb : The conversion ratio = b/t・√(F/E)

Γb = 1.06

a) Γb ≦ 1.34 fc = F/1.5

b) 1.34 < Γb ≦ 2.69 fc = F − 0.248FΓb

c) 2.69 < Γb fc = 2.41 F/(Γb2)

fb= 120.0 N/mm^2

2) Web plate <side face>

Γd : The conversion ratio = d/t・√(F/E)

Γd = 4.48

a) Γd ≦ 3.29 fb = F/1.5

b) 3.29 < Γd ≦ 6.57 fb = F − 0.101FΓd

c) 6.57 < Γd fb = 14.4 F/($Γd^2$)

fb= 98.6 N/mm^2

Therefore, result date is・・・

fbx= 98.6 N/mm^2

fbx= 148.0 N/mm^2

Permissible bending stress degree (weak axis)

1) Frange plate <top/bottom face>

Γb : The conversion ratio = b/t・√(F/E)

Γb= 4.48

a) Γb ≦ 1.34	fc =	F/1.5
b) 1.34 < Γb ≦ 2.6 9	fc =	F − 0.248FΓd
c) 2.69 < Γb	fc =	2.41 F/(Γd2)

fb= 21.7 N/mm^2

2) Web plate <side face>

Γd : The conversion ratio = d/t・√(F/E)

Γd= 1.06

a) Γd ≦ 3.29	fb =	F/1.5
b) 3.29 < Γd ≦ 6.57	fb =	F − 0.101FΓd
c) 6.57 < Γd	fb =	14.4 F/($Γd^2$)

fb= 120.0 N/mm^2

Therefore, result date is・・・

fby= 21.7 N/mm^2

fby= 32.5 N/mm^2

Examination of the section of the post

Short period snow load

σb= 77.3 N/mm^2

σc=N/A= 2.8 N/mm^2

σb/fb+σc/fc= 0.61 <1.0 OK !

Wind blow down

σb= 78.9 N/mm^2

σc=N/A= 2.1 N/mm^2

σb/fb+σc/fc= 0.60 <1.0 OK !

Wind blow up

σb= 98.0 N/mm^2

σt=N/A= 2.7 N/mm^2

σb/fb+σt/ft= 0.68 <1.0 OK !

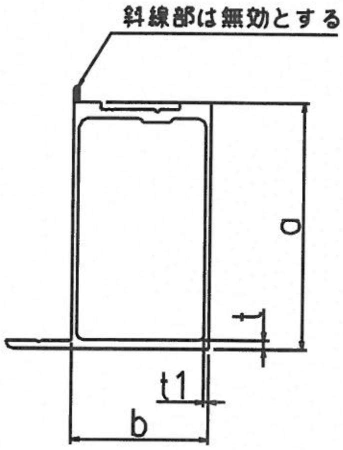
2・lk/i= 115.6 <140 OK !

7. Main Frame Bending permissible stress degree

7-1 Bending permissible stress degree

	Permissible stress degree for long period (N/mm2)	Permissible stress for short period(N/m3)
$b\lambda \leqq b\lambda p$	F/ν	Long period x 1.5
$b\lambda p < b\lambda \leqq b\lambda e$	$(1.0-0.5((b\lambda - b\lambda p)/(b\lambda e - b\lambda p)))F/\nu$	Long period x 1.5
$b\lambda e < b\lambda$	$(1/b\lambda^2)\cdot(F/\nu)$	Long period x 1.5

a=	4.60	cm
t=	0.10	cm
t1=	0.09	cm
b=	2.50	cm
Young's modulus factor E=	70000	N/mm^2
Shear elasticity factor of bending materialG=	27000	Nmm
Torsion fixed number of bending material=	3.2	cm^4
Second section moment around weak axis Iy=	2.072	cm^4
Section factor of bending direction Z=	2.274	cm^3
F:Standard strength(N/mm2)=	180	N/mm^2
$b\lambda=\sqrt{}(My/Me)$=	0.27	
$Me=C\sqrt{}((\pi 2EIyGJ)/lb2)$=	5535840	Nmm
Bending moment My=	409320	Nmm
C=	1.13	
lb=	715	mm
$b\lambda p$=0.6+0.3(M2/M1)=	0.3	
$b\lambda e=1/\sqrt{}0.5$=	1.41	



$\nu=3/2+2(b\lambda/b\lambda e)^2/3$ (its value assumes 2.17 in case more than 2.17)

ν = 1.52

$b\lambda \leqq b\lambda p$

fb= 118.1 N/mm^2

Permissible stress degree at bend parts

1) Frange plate of beam <top/bottom face>

Γb : The conversion ratio = b/t・√(F/E)

Γb = 0.41

a) Γb ≦ 0.438 fb = F/1.5

b) 0.438 < Γb ≦ 0.876 fb = F − 0.760FΓb

c) 0.876 < Γb fb = 0.256 F/(Γb^2)

fb= 120.0 N/mm^2

Γb : The conversion ratio = b/t・√(F/E)

Γb = 1.18

a) Γb ≦ 1.34 fc = F/1.5

b) 1.34 < Γb ≦ 2.69 fc = F − 0.248FΓd

c) 2.69 < Γb fc = 2.41 F/(Γd2)

fb= 120.0 N/mm^2

2) Wave plate of beam <side face>

Γb : The conversion ratio = b/t・√(F/E)

Γd = 2.48

a) Γd ≦ 3.29 fb = F/1.5

b) 3.29 < Γd ≦ 6.57 fb = F − 0.101FΓ

c) 6.57 < Γd fb = 14.4 F/(Γd^2)

fb= 120.0 N/mm^2

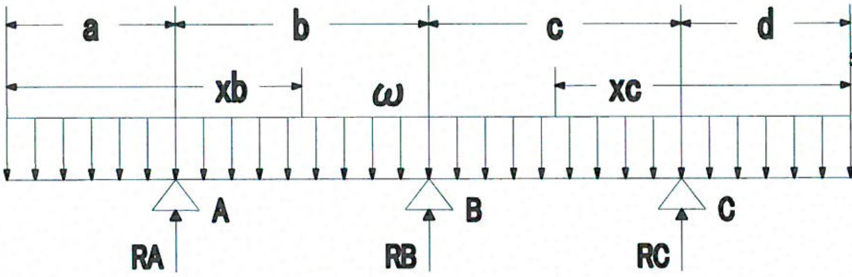
Therefore, result data is…

fb= 118.1 N/mm^2

fb= 177.1 N/mm^2

7-2 Calculation of Main Frame Section

Parts Width= 0.645 m



Long period snow ω=	38.7	N/m
Short period snow load ω=	425.8	N/m
Short period blow down ω=	312.6	N/m
Short period blow up ω=	417.9	N/m
ω=	425.8	N/m

a=	0.7385	m
b=	1.775	m
c=	1.775	m
d=	0.7385	m
xb=	1.25675	m
xc=	1.25675	m
Z=	2.274	cm^3
I=	5.325	cm^4
E=	7000000	N/cm^2

W=Full-Load M=Bend Moment
R=Anti-Power θ =Rotation Angle
Q=Shear Power δ =Bend

W= w(a+b+c+d)	=	2140.3 N
RA= $w(6a^2b+4a^2c+8ab^2+8abc+3b^3+4b^2c-c^3+2cd^2)/8b(b+c)$	=	695.9 N
RB= $w(4b^2c+4bc^2-4bd^2-2a^2b-2cd^2+c^3-4a^2c+b^3)/8bc$	=	748.4 N
RC= $w(6cd^2+4bd^2++8c^2d+8bcd+3c^3+4bc^2-b^3+2a^2b)/8c(b+c)$	=	695.9 N
MA= $-(wa^2/2)$	=	-116.1 N·m
σA= MA/Z	=	51.1 N/mm^2
MB= $w[b(2a^2-b^2)+c(2d^2-c^2)]/8(b+c)$	=	-109.6 N·m
σB= MB/Z	=	48.2 N/mm^2
MC= $-(wd^2/2)$	=	-116.1 N·m
σC= MC/Z	=	51.1 N/mm^2
MXb= $-wx^2/2+RA(x-a)$	=	24.4 (b material)
σXb= MX/Z	=	10.7 N/mm^2
MXc= $-wx^2/2+RC(x-d)$	=	24.4 (c material)
σXc= MX/Z	=	10.7 N/mm^2
σb/fb	=	0.29 <1.0 OK !

8. Front frame bending permissible stress degree

8-1 Bending permissible stress degree

	Permissible stress degree for long period (N／mm2)	Permissible stress for short period(N/m3)
bλ≦bλp	F/ν	Long period x 1.5
bλp<bλ≦bλe	(1.0−0.5((bλ−bλp)/(bλe−bλp)))F/ν	Long period x 1.5
bλe<bλ	$(1/b\lambda^2)\cdot(F/\nu)$	Long period x 1.5

a=	4.77	cm
t=	0.10	cm
t1=	0.10	cm
b=	4.20	cm

Young's modulus factor E= 70000 N/mm^2

Shear elasticity factor of bending materialG= 27000 Nmm

Torsion fixed number of bending material= 8.4 cm^4

Second section moment around weak axis Iy= 6.911 cm^4

Section factor of bending direction Z= 3.805 cm^3

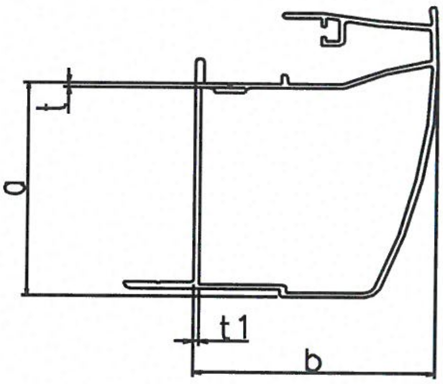
F:Standard strength(N／mm2)= 132 N/mm^2

bλ=√(My/Me)= 0.17

Me=C√((π 2EIyGJ)/lb2)= 16407392 Nmm

Bending moment My= 502260 Nmm

C= 1.13



lb= 715 mm

bλp=0.6+0.3(M2/M1)= 0.3

bλe=1/√0.5= 1.41

$\nu=3/2+2(b\lambda/b\lambda e)^2/3$ (its value assumes 2.17 in case more than 2.17)

ν= 1.51

bλ≦bλp

fb= 87.4 N/mm^2

Permissible stress degree at bend parts

1) Frange plate of beam <top/bottom face>

Γb : The conversion ratio = b/t・√(F/E)

Γb = 1.74

a) Γb ≦ 1.34 fc = F/1.5

b) 1.34 < Γb ≦ 2.69 fc = F − 0.248FΓd

c) 2.69 < Γb fc = 2.41 F/(Γd2)

fb= 75.1 N/mm^2

2) Web plate of beam <side face>

Γd = d/t・√(F/E)

Γd = 1.98

a) Γd ≦ 3.29 fb = F/1.5

b) 3.29 < Γd ≦ 6.57 fb = F − 0.101FΓ

c) 6.57 < Γd fb = 14.4 $F/(\Gamma d^2)$

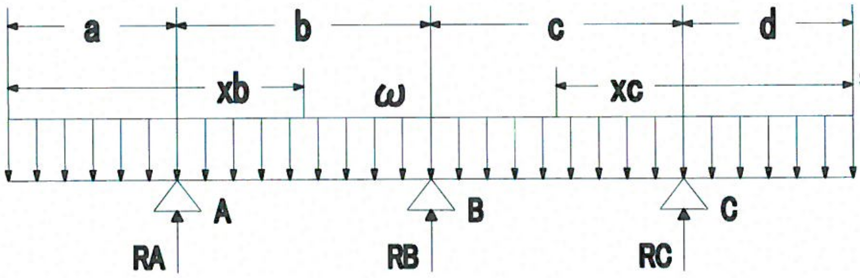
fb= 88.0 N/mm^2

Therefore, result data is…

fb= 75.1 N/mm^2

fb= 112.7 N/mm^2

8-2 Calculation of Front Frame Section



Parts Width=	0.323	m
Long period snow ω=	19.4	N/m
Short period snow load ω=	212.9	N/m
Short period blow down ω=	156.3	N/m
Short period blow up ω=	208.9	N/m
ω=	212.9	N/m
a=	0.7385	m
b=	1.775	m
c=	1.775	m
d=	0.7385	m
xb=	1.25675	m
xc=	1.25675	m
Z=	3.805	cm^3
I=	12.495	cm^4
E=	7000000	N/cm^2

W=Full-Load M=Bend Moment
R=Anti-Power θ=Rotation Angle
Q=Shear Power δ=Bend

W= w(a+b+c+d)	=	1070.2	N
RA= $w(6a^2b+4a^2c+8ab^2+8abc+3b^3+4b^2c-c^3+2cd^2)/8b(b+c)$	=	348.0	N
RB= $w(4b^2c+4bc^2-4bd^2-2a^2b-2cd^2+c^3-4a^2c+b^3)/8bc$	=	374.2	N
RC= $w(6cd^2+4bd^2++8c^2d+8bcd+3c^3+4bc^2-b^3+2a^2b)/8c(b+c)$	=	348.0	N
MA= $-(wa^2/2)$	=	-58.1	N・m
σA= MA/Z	=	15.3	N/mm^2
MB= $w[b(2a^2-b^2)+c(2d^2-c^2)]/8(b+c)$	=	-54.8	N・m
σB= MB/Z	=	14.4	N/mm^2
MC= $-(wd^2/2)$	=	-58.1	N・m
σC= MC/Z	=	15.3	N/mm^2
MXb= $-wx^2/2+RA(x-a)$	=	12.2	(b material)
σXb= MX/Z	=	3.2	N/mm^2
MXc= $-wx^2/2+RC(x-d)$	=	12.2	(c material)
σXc= MX/Z	=	3.2	N/mm^2
σb/fb	=	0.14	<1.0 OK !

9. **Bending permissible stress degree at rear frame**

9-1 **Calculation method of effective section**

$\Gamma b = b/t \cdot \sqrt{(F/E)} = 0.438$ Therefore…

$b/t = 0.438/\sqrt{(F/E)} = 10.09$

Effective Depth

t2= 1.70 mm

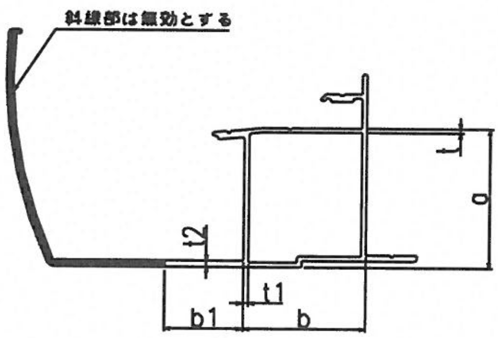
b1= 17.15 mm

9-2. Bending permissible stress degree at rear frame

Bending permissible stress degree

	Permissible stress degree for long period (N／mm2)	Permissible stress for short period(N/m3)
$b\lambda \leqq b\lambda p$	F/ν	Long period x 1.5
$b\lambda p < b\lambda \leqq b\lambda e$	$(1.0-0.5((b\lambda - b\lambda p)/(b\lambda e - b\lambda p)))F/\nu$	Long period x 1.5
$b\lambda e < b\lambda$	$(1/b\lambda^2) \cdot (F/\nu)$	Long period x 1.5

a=	3.82	cm
t=	0.12	cm
t1=	0.12	cm
b=	2.95	cm



Young's modulus factor E=	70000	N/mm^2
Shear elasticity factor of bending materialG＝	27000	Nmm
Torsion fixed number of bending material＝	4.0	cm^4
Second section moment around weak axis Iy=	7.702	cm^4
Section factor of bending direction Z=	2.344	cm^3
F: Standard strength (N／mm2) ＝	132	N/mm^2
$b\lambda = \sqrt{(My/Me)}$=	0.16	
$Me = C\sqrt{((\pi^2 EIyGJ)/lb^2)}$=	12025195	Nmm
Bending moment My=	309408	Nmm
C=	1.13	
lb=	715	mm
$b\lambda p = 0.6+0.3(M2/M1)$=	0.3	
$b\lambda e = 1/\sqrt{0.5}$=	1.41	

$\nu = 3/2 + 2(b\lambda / b\lambda e)^2/3$ (its value assumes 2.17 in case more than 2.17)

ν = 1.51

$b\lambda \leqq b\lambda p$

fb= 87.5 N/mm^2

Permissible stress degree at bend parts

1) Frange plate of beam <top/bottom face>

Γb : The conversion ratio ＝ $b/t \cdot \sqrt{(F/E)}$

Γb = 0.98

a) $\Gamma b \leqq 1.34$ fc ＝ F/1.5

b) $1.34 < \Gamma b \leqq 2.69$ fc ＝ F − 0.248FΓd

c) $2.69 < \Gamma b$ fc ＝ 2.41 F/(Γd2)

fb= 88.0 N/mm^2

2) Web plate of beam <side face>

$\Gamma d = d/t \cdot \sqrt{(F/E)}$

Γd = 1.30

a) $\Gamma d \leqq 3.29$ fb ＝ F/1.5

b) $3.29 < \Gamma d \leqq 6.57$ fb ＝ F − 0.101FΓ

c) $6.57 < \Gamma d$ fb ＝ 14.4 F/(Γd^2)

fb= 88.0 N/mm^2

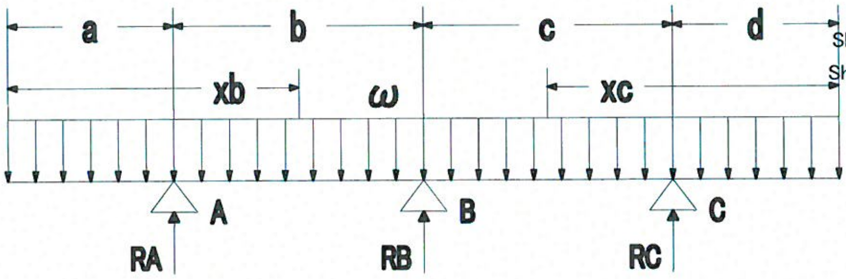
Therefore, result data is…

fb= 87.5 N/mm^2

fb= 131.2 N/mm^2

9-3 Calculation of Rear Frame Section

Parts Width＝ 0.323 m



Long period snow ω=	19.4 N/m
Short period snow load ω=	212.9 N/m
Short period blow down ω=	156.3 N/m
Short period blow up ω=	208.9 N/m
ω=	212.9 N/m
a=	0.7385 m
b=	1.775 m
c=	1.775 m
d=	0.7385 m
xb=	1.25675 m
xc=	1.25675 m
Z=	2.344 cm^3
I=	7.702 cm^4
E=	7000000 N/cm^2

W=Full-Load　M=Bend Moment
R=Anti-Power　θ=Rotation Angle
Q=Shear Power　δ=Bend

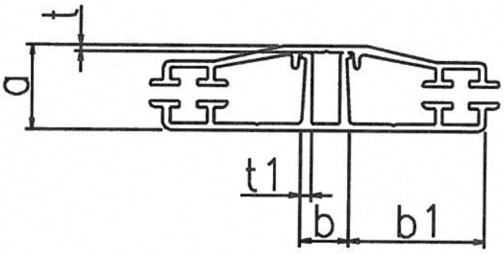
W= w(a+b+c+d)	=	1070.2 N
RA= $w(6a^2b+4a^2c+8ab^2+8abc+3b^3+4b^2c-c^3+2cd^2)/8b(b+c)$	=	348.0 N
RB= $w(4b^2c+4bc^2-4bd^2-2a^2b-2cd^2+c^3-4a^2c+b^3)/8bc$	=	374.2 N
RC= $w(6cd^2+4bd^2++8c^2d+8bcd+3c^3+4bc^2-b^3+2a^2b)/8c(b+c)$	=	348.0 N
MA= $-(wa^2/2)$	=	-58.1 N･m
σA= MA/Z	=	24.8 N/mm^2
MB= $w[b(2a^2-b^2)+c(2d^2-c^2)]/8(b+c)$	=	-54.8 N･m
σB= MB/Z	=	23.4 N/mm^2
MC= $-(wd^2/2)$	=	-58.1 N･m
σC= MC/Z	=	24.8 N/mm^2
MXb= $-wx^2/2+RA(x-a)$	=	12.2 (b material)
σXb= MX/Z	=	5.2 N/mm^2
MXc= $-wx^2/2+RC(x-d)$	=	12.2 (c material)
σXc= MX/Z	=	5.2 N/mm^2
σb/fb	=	0.19 ＜1.0　OK ！

10. Rafter / Roof retainer bending permissible stress degree

10-1 Bending permissible stress degree

a=	1.30	cm
t=	0.10	cm
t1=	0.17	cm
b=	0.72	cm
b1=	1.99	cm

Young's modulus factor E=	70000	N/mm^2
Shear elasticity factor of bending materialG=	27000	Nmm
Second section moment around weak axis Iy=	0.364	cm^4
Section factor of bending direction Z=	0.529	cm^3
F:Standard strength(N/mm2)=	132	N/mm^2



Therefore…

fb= 88.0 N/mm^2

Permissible stress degree at bend parts

Frange plate of beam <top/bottom face>

Γb : The conversion ratio = $b/t \cdot \sqrt{(F/E)}$

Γb = 0.86

a) Γb ≦ 0.438 fb = F/1.5

b) 0.438 < Γb ≦ 0.876 fb = F − 0.760FΓb

c) 0.876 < Γb fb = 0.256 F/(Γb2)

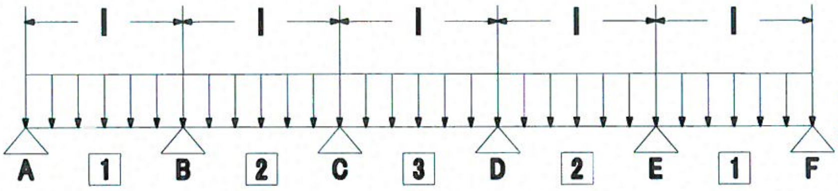
fb= 45.3 N/mm^2

Therefore…

fb= 45.3 N/mm^2

fb= 68.0 N/mm^2

10-2 Calculation of Rafter / Roof retainer section



Parts Width=	0.715 m
l=	0.645 m
Long period ω=	42.9 N/m
Short period snow load ω=	471.9 N/m
Short period blow down ω=	346.5 N/m
Short period blow up ω=	-463.1 N/m
ω=	471.9 N/m
Z=	0.529 cm^3
I=	0.364 cm^4
E=	7000000 N/cm^2

W=Full-Load M=Bend Moment
R=Anti-Power θ=Rotation Angle
Q=Shear Power δ=Bend

	ωl	=	304.4 N
RA=	0.395 ＊ ωl	=	120.2 N
RB=	1.131 ＊ ωl	=	344.3 N
RC=	0.974 ＊ ωl	=	296.5 N
RD=	0.974 ＊ ωl	=	296.5 N
RE=	1.131 ＊ ωl	=	344.3 N
RF=	0.395 ＊ ωl	=	120.2 N
Rmax=			344.3 N
MB=	-0.105+ ＊ $ωl^2$	=	-20.6 N・m
MC=	-0.079 ＊ $ωl^2$	=	-15.5 N・m
MD=	-0.079 ＊ $ωl^2$	=	-15.5 N・m
ME=	-0.105+ ＊ $ωl^2$	=	-20.6 N・m
M1=	0.078 ＊ $ωl^2$	=	15.3 N・m
M2=	0.033 ＊ $ωl^2$	=	6.5 N・m
M3=	0.046 ＊ $ωl^2$	=	9.0 N・m
σX=	MX/Z	=	39.0 N/mm^2
	σb/fb	=	0.57 ＜1.0 OK !

11. Side frame bending permissible stress degree

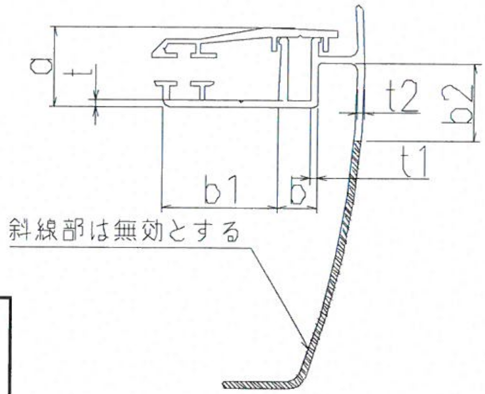
11-1 Calculation method of effective section

Γb = b/t・√(F/E)= 0.438 Therefore…

b/t = 0.438/√(F/E)= 10.09

Effective Depth

t2=	1.20	mm
b2=	12.10	mm



11-2 Bending permissible stress degree

a=	1.30	cm
t=	0.11	cm
t1=	0.17	cm
b=	0.72	cm
b1=	1.99	cm
Young's modulus factor E=	70000	N/mm^2
Shear elasticity factor of bending materialG=	27000	Nmm
Second section moment around weak axis Iy=	2	cm^4
Section factor of bending direction Z=	0.324	cm^3
F:Standard strength(N/mm2)=	132	N/mm^2

Therefore…

fb= 88.0 N/mm^2

Permissible stress degree at bend parts

Frange plate of beam <top/bottom face>

Γb : The conversion ratio = b/t・√(F/E)

Γb = 0.79

a) Γb ≦ 0.438 fb = F/1.5

b) 0.438 < Γb ≦ 0.876 fb = F − 0.760FΓb

c) 0.876 < Γb fb = 0.256 F/(Γb2)

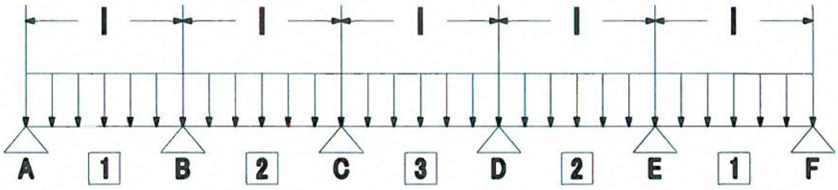
fb= 53.2 N/mm^2

Therefore…

fb= 53.2 N/mm^2

fb= 79.8 N/mm^2

11-3 Calculation of Side frame secton



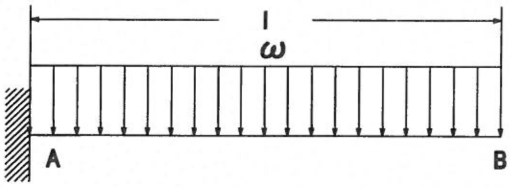
Parts Width=	0.363	m
l=	0.645	m
Long period ω=	21.8	N/m
Short period snow load ω=	239.6	N/m
Short period blow down ω=	175.9	N/m
Short period blow up ω=	-235.1	N/m
ω=	239.6	N/m
Z=	0.324	cm^3
I=	0.399	cm^4
E=	7000000	N/cm^2

W=Full-Load M=Bend Moment
R=Anti-Power θ=Rotation Angle
Q=Shear Power δ=Bend

	ωl	=	154.6 N
RA=	0.395 ＊ ωl	=	61.0 N
RB=	1.131 ＊ ωl	=	174.8 N
RC=	0.974 ＊ ωl	=	150.5 N
RD=	0.974 ＊ ωl	=	150.5 N
RE=	1.131 ＊ ωl	=	174.8 N
RF=	0.395 ＊ ωl	=	61.0 N
Rmax=			174.8 N
MB=	-0.105+ ＊ ωl^2	=	-10.5 N・m
MC=	-0.079 ＊ ωl^2	=	-7.9 N・m
MD=	-0.079 ＊ ωl^2	=	-7.9 N・m
ME=	-0.105+ ＊ ωl^2	=	-10.5 N・m
M1=	0.078 ＊ ωl^2	=	7.8 N・m
M2=	0.033 ＊ ωl^2	=	3.3 N・m
M3=	0.046 ＊ ωl^2	=	4.6 N・m
σX=	MX/Z	=	32.3 N/mm^2
	σb/fb	=	0.40 <1.0 OK !

12. Corner bracket examination

12-1 Beam load



Load chart

Type			
Vertical load width (m)			1.775
l (m)	D-d1		3.225
Load ω (N/m)	Long period load		106.5
	Short period snow load		1171.5
	Short period blowing up(vertical)		860.2
	Short period blowing up(vertical)		-1043.2
	Short period blowing down(horizontal)		160.5
	Short period earthquake(vertical)		106.5
	Short period earthquake(horizontal)		32.0
Bending moment M(N·m)	Long period load		553.8
	Short period snow load		6092.2
	Short period blowing up(vertical)		4473.5
	Short period blowing up(vertical)		-5425.1
	Short period blowing down(horizontal)		834.7
	Short period earthquake(vertical)		553.8
	Short period earthquake(horizontal)		166.1
Maximum bending momen (N·m)	maxMx	(long period)	
		(short period)	6092.2
	maxMy	(long period)	
		(short period)	834.7
Second section moment	Ix(cm^4)		231.7
	Iy(cm^4)		60.7
Section factor	Zx(cm^3)		37.4
	Zy(cm^3)		18.1
Elasticity factor	E(N/cm^2)		21000000
Maximum bending stress degree (N/mm2)	max σx		163.0
	max σy		46.0
Vertical maximum deformation quantity	max δx	(cm)	3.26
	max δx/l	1/	154
Flat maximum deformation quantity	max δy	(cm)	1.70
	max δy/l	1/	295

12-2 Calculation of Corner bracket Section

Material	Second section moment		Section factor	
	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)
GB8064	205.211	65.073	28.119	20.335

fb= 420 N/mm^2
Mx= 6092.2 N·m
My= 834.7 N·m

σbx= 216.7 N/mm^2
$\sigma$by= 41.0 N/mm^2

σbx/fb= 0.52 <1.0 OK !
$\sigma$by/fb= 0.10 <1.0 OK !

13. Examination of main frame connecting part

13-1 Calculation of Load

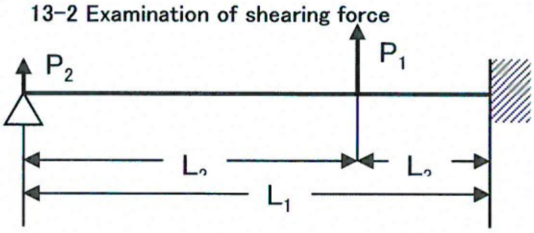
・Anti-Power of rafter

P_1= P1= 344.3 N ←from "Calculation of rafter"

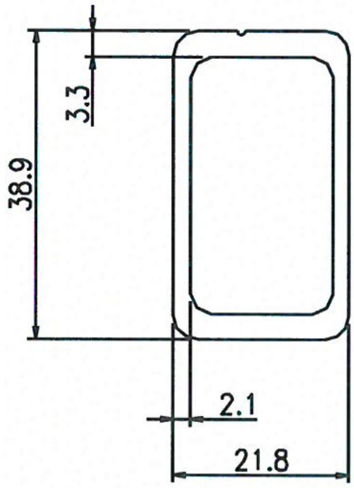
・Anti-Power of connecting rafter

P_2= P2= 172.2 N ←(Anti-Power of rafter)/2

13-2 Examination of shearing force



L_1(m)	0.74
L_2(m)	0.715
L_3(m)	0.02
A(mm^2)	276.8
fs(N/mm^2)	76.2



$Q = (P_1 \cdot L_3^2)\cdot(3L_2+2L_3)/(2L_1^3)+P_2$ より

Q= 172.7 N

τ =Q/A= 0.62 N/mm^2

τ /fs= 0.01 <1.0 OK !

14. Examination of front frame connecting part

14-1 Calculation of Load

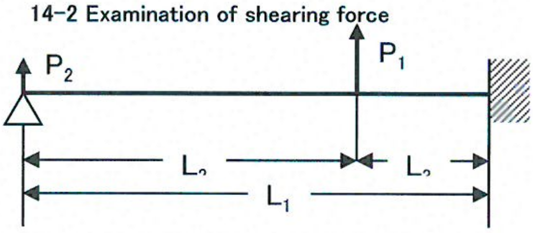
・Anti-Power of rafter

P_1= P1= 120.2 N ←from "Calculation of rafter"

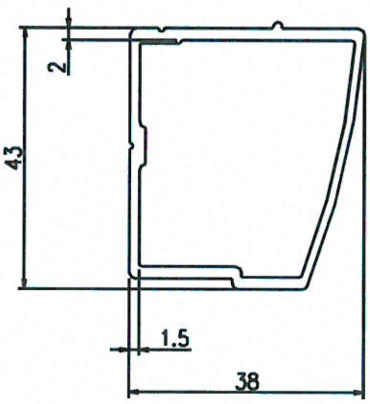
・Anti-Power of connecting rafter

P2= 60.1 N ←(Anti-Power of rafter)/2

14-2 Examination of shearing force



L_1(m)	0.74
L_2(m)	0.715
L_3(m)	0.02
A(mm^2)	261.6
fs(N/mm^2)	76.2



$Q = (P_1 \cdot L_3^2)\cdot(3L_2+2L_3)/(2L_1^3)+P_2$ より

Q= 60.3 N

τ =Q/A= 0.23 N/mm^2

τ /fs= 0.01 <1.0 OK !

15. Examination of gutter connecting part

15-1 Calculation of Load

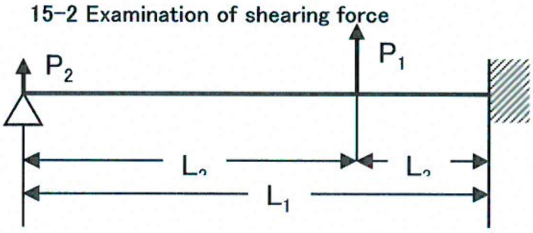
・Anti-Power of rafter

P1= 120.2 N ←from "Calculation of rafter"

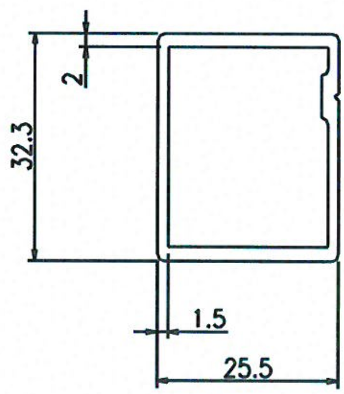
・Anti-Power of connecting rafter

P2= 60.1 N ←(Anti-Power of rafter)/2

15-2 Examination of shearing force



L_1(m)	0.74
L_2(m)	0.715
L_3(m)	0.02
A(mm^2)	192.1
fs(N/mm^2)	76.2



$Q = (P_1 \cdot L_3^2)\cdot(3L_2+2L_3)/(2L_1^3)+P_2$ より

Q= 60.3 N

τ =Q/A= 0.31 N/mm^2

τ /fs= 0.01 <1.0 OK !

16. Examination of main frame and beam connection

16-1 Examination of screw pull-out force

・Pull-out force/screw

T= 374.2 N

・Stretching permissible stress

$ft= 2.1 \cdot \beta \cdot ((d^2-d_1^2)/(P \cdot d^4))^{0.5} \cdot t^{1.2} \cdot Ft \cdot 1.5$

= 172.7 N/mm^2

・Effective section

A= 11.2 mm^2

σt= 33.3 N/mm^2

$\sigma t/ft$= 0.19 <1.0 OK !

β	0.6
Screw diameter	5
Core diameter	3.78
Pitch	0.8
t(Thickness)	4.6
Ft(Standard strength)	100

16-2 Examination of Beam bending stress

・Beam top face bending moment

M= 2099.6 N・mm

Z= 58.6 mm^3

σb= 35.9 N/mm^2

$\sigma b/fb$= 0.17 <1.0 OK !

b(Beam depth dimension)	61
t(Thickness)	2.4
a(load point)	18.5

17. Examination of rafter and main frame connection

17-1 Examination of screw pull-out force

・Pull-out force/screw

T= 344.3 N

・Stretching permissible stress

$ft= 2.1 \cdot \beta \cdot ((d^2-d_1^2)/(P \cdot d^4))^{0.5} \cdot t^{1.2} \cdot Ft \cdot 1.5$

= 104.5 N/mm^2

・Effective section

A= 6.7 mm^2

σt= 51.1 N/mm^2

$\sigma t/ft$= 0.49 <1.0 OK !

β	0.6
Screw diameter	4
Core diameter	2.93
Pitch	0.7
t(Thickness)	2.3
Ft(Standard strength)	100

17-2 Examination of Main frame bending stress

・Main frame top face bending moment

M= 991.6 N・mm

Z= 22.0 mm^3

σb= 45.0 N/mm^2

$\sigma b/fb$= 0.22 <1.0 OK !

b(Beam depth dimension)	25
t(Thickness)center	2.3
a(load point)	10

18. Examination of Roof material

18-1 Examination of Bending volume

Poisson ratio : ν =	0.3	
Distribution Load : P=	0.0116	kgf/cm^2
E: Young's modulus factor =	21000	kgf/cm^2
Thickness : h=	0.18	cm
Short edge a=	70.3	cm
Long edge b=	326.4	cm

Bending volume : Wmax

$A \cdot Wmax^3 + B \cdot Wmax + C = 0$

$A = (4\nu/a^2b^2 + (3-\nu^2)\cdot(1/a^4+1/b^4))/h^3$

= 2086.4

$B = (4/3)\cdot(1/a^2+1/b^2)^2/h$

= 33.2

$C = -256(1-\nu^2)P/(\pi^6 E h^4)$

= −12701.0

Bending volume : Wmax= 1.82 cm

18-2 Bending stress degree

$max\,\sigma x = ((\pi^2 \cdot E \cdot Wmax)/(8\cdot(1-\nu^2)))\cdot((2-\nu^2)Wmax+4h)/a^{2+}(\nu\,(Wmax+4h))/b2)$

= 44.5 kgf/cm^2 < 551 kgf/cm^2 ∴OK !

18-3 Necessary depth of insert

Necessary depth of insert ΔL

ΔL = ΔX x SF + ΔI

However, ΔX : The gap volume by a bend

= (Ix − b)／2

Ix : Arc length while bending

= 2 x sin-1〔(b／2)／r〕x r

r : Radius rate while bending

= (b2+4δ2)／8δ

δ : Bending rate of Polycarbonate = Wmax (cm)

b : Length of short (cm)

ΔI : The volume of expansion and contraction at temperature

= K・Δt・b／2

K : Line coefficient of expansion (cm／cm／℃)

Δt : Temperature differency at 50℃

SF : Safety ratio SF=3. 0

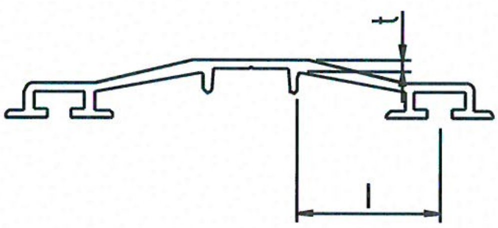
r=	339.8	
Ix=	70.43	cm
ΔX=	0.06	cm
K=	0.00007	cm/cm/℃
Δt =	50	℃
SF=	3.0	
ΔI=	0.12	cm

Therefore…

ΔL= 0.31 cm depth or more < 1.89 cm ∴OK !

19. Examination of Roof retainer

Rafter pitch=	715	mm
Supporting length I=	15	mm
Material thickness t=	1.2	mm
F: Standard strength=	132	N/mm^2
Blow up load ω=	383.4	N/m
Load P=ωb=	3.834	N
M=P・I=	5.8	Ncm
Section factor Z=bt^2／6=	0.002	cm^3
σb=M/Z=	24.0	N/mm^2



σb/fb= 0.18 <1.0 OK !

20. Ground Foundation

20-1 Without concrete floor

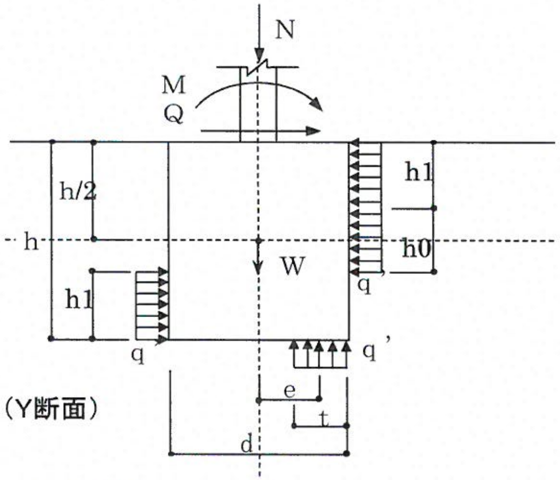
Resistance moment

$M_R=(N+W)\times e+q's\times b\times h_1\times(h_1+h_0)$

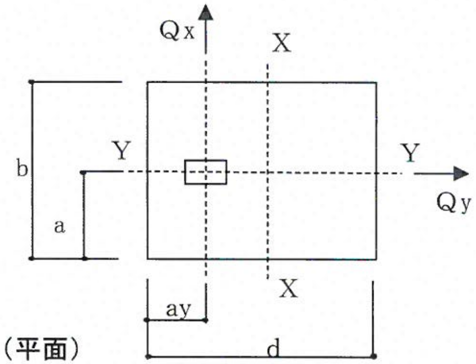
Resistance moment

$M=M'+Q*(h/2)-N\times(d/2-a)$

Base Foundation	
Lateral Pressure	**0.5**
b=	0.90 m
d=	1.10 m
h=	0.55 m
ay=	0.30 m
ax=	0.45 m
Endurance strength of ground Fe=	100 KN/m^2
Short Term Permissible Endurance strength of ground q=	200 KN/m^2
No line concrete Volume weight	22.5 KN/m^3



(Y断面)



(平面)

	Spindle Force(N)	Shear power(N)		Moment(Nm)		Foundation size(m)				Base Weight	Endurance strength of ground	Lateral Pressure
	N	Qx	Qy	M' x	M' y	b	d	h	a	W(N)	q'(kN/m2)	's(kN/m2)=0.5
Long period load	434.2	0.0	0.0	528.4	0.0	0.90	1.10	0.55	0.30	12,251	100	50.0
Short period load	3948.7	0.0	0.0	5812.1	0.0	0.90	1.10	0.55	0.30	12,251	200	100.0
Short term earthquake X	434.2	99.5	0.0	528.4	224.0	0.90	1.10	0.55	0.30	12,251	200	100.0
Short term earthquake Y	434.2	0.0	99.5	752.3	0.0	0.90	1.10	0.55	0.30	12,251	200	100.0
Short period blow down + Holizontal	2921.5	677.5	0.0	4267.9	1524.5	0.90	1.10	0.55	0.30	12,251	200	100.0
Short period blow down + Holizontal	2921.5	0.0	738.0	5928.4	0.0	0.90	1.10	0.55	0.30	12,251	200	100.0
Short period blow up+Holizontal X	-3711.4	677.5	0.0	-5704.1	1524.5	0.90	1.10	0.55	0.30	12,251	200	100.0
Short period blow up+Holizontal Y	-3711.4	0.0	-738.0	-7364.7	0.0	0.90	1.10	0.55	0.30	12,251	200	100.0

■Examination of subsidence (short period snow)

subsidence load		Endurance strength of ground	
N+W (N)	<	b×d×q (N)	
16200		198000	∴OK !

■Examination of uplift (short period blow up)

uplift load		Base weight	
N (N)	<	b×d×h×γ(N)	
3711		12251	∴OK !

	X direction							
	t(m)	e(m)	h0(m)	h1(m)	Resistance MRx	Fall Mx		JUDGMENT
	(N+W)/(b×q')	(d-t)/2	Qy/(b×q's)	(h-h0)/2	MRx(N·m)	Mx(N·m)	Mx/MRx	MR≧M
Long period load	0.141	0.480	0.000	0.275	9,486	419.8	0.044	<1.0 OK !
Short period load	0.090	0.505	0.000	0.275	14,987	4824.9	0.322	<1.0 OK !
Short term earthquake X	0.070	0.515	0.000	0.275	13,336	419.8	0.031	<1.0 OK !
Short term earthquake Y	0.070	0.515	0.001	0.274	13,336	671.1	0.050	<1.0 OK !
Short period blow down + Holizontal X	0.084	0.508	0.000	0.275	14,512	3537.5	0.244	<1.0 OK !
Short period blow down + Holizontal Y	0.084	0.508	0.008	0.271	14,510	5401.0	0.372	<1.0 OK !
Short period blow up+Holizontal X	0.047	0.526	0.000	0.275	11,301	-4776.3	0.423	<1.0 OK !
Short period blow up+Holizontal Y	0.047	0.526	0.008	0.271	11,299	-6639.8	0.588	<1.0 OK !

	Y direction							
	t(m)	e(m)	h0(m)	h1(m)	Resistance MRx	Fall Mx		JUDGMENT
	(N+W)/(d×q')	(b-t)/2	Qx/(d×q's)	(h-h0)/2	MRy(N·m)	My(N·m)	My/Mry	MR≧M
Short term earthquake X	0.058	0.421	0.001	0.275	12,149	251.3	0.021	<1.0 OK !
Short period blow down + Holizontal X	0.069	0.416	0.006	0.272	13,110	1710.8	0.130	<1.0 OK !
Short period blow up+Holizontal X	0.039	0.431	0.006	0.272	10,483	1710.8	0.163	<1.0 OK !

21-1 With concrete floor

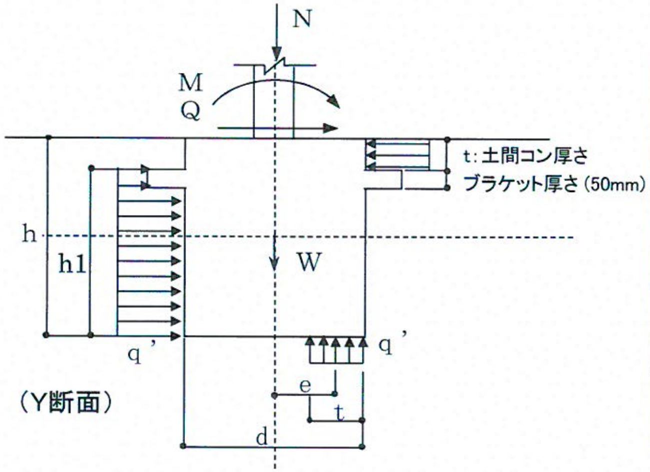
Resistance moment

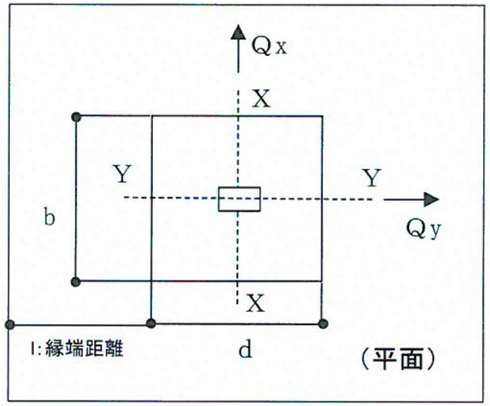
M_R=(N+W)×e+q's×b×h_1×h_1/2

Fall moment

M=M' +Q*(h/2)

	Base Foundation	
Lateral Pressure	**0.5**	
b=	0.60	m
d=	0.45	m
h=	0.55	m
h_1=	0.45	m
l=	0.35	m
Concrete floor thickness t=	0.10	m
Endurance strength of ground Fe=	50	KN/m^2
Short Term Permissible Endurance strength of ground q=	100	KN/m^2
No line concrete Volume weight γ=	22.5	KN/m^3
Concrete standard strength Fc=	15000	KN/m^3





	Spindle Force(N)	Shear power(N)		Moment(Nm)		Foundation size(m)					Base Weight	Endurance strength of ground	Lateral Pressure
	N	Qx	Qy	M' x	M' y	b	d	h	nd part lengt	oor thicknes	W(N)	q'(kN/m2)	's(kN/m2)=0.5c
Long period load	434.2	0.0	0.0	528.4	0.0	0.60	0.45	0.55	0.35	0.10	3,341	50	25.0
Short period load	3948.7	0.0	0.0	5812.1	0.0	0.60	0.45	0.55	0.35	0.10	3,341	100	50.0
Short term earthquake X	434.2	99.5	0.0	528.4	224.0	0.60	0.45	0.55	0.35	0.10	3,341	100	50.0
Short term earthquake Y	434.2	0.0	99.5	752.3	0.0	0.60	0.45	0.55	0.35	0.10	3,341	100	50.0
Short period blow down + Holizontal X	2921.5	677.5	0.0	4267.9	1524.5	0.60	0.45	0.55	0.35	0.10	3,341	100	50.0
Short period blow down + Holizontal Y	2921.5	0.0	738.0	5928.4	0.0	0.60	0.45	0.55	0.35	0.10	3,341	100	50.0
Short period blow up+Holizontal X	−3711.4	677.5	0.0	−5704.1	1524.5	0.60	0.45	0.55	0.35	0.10	3,341	100	50.0
Short period blow up+Holizontal Y	−3711.4	0.0	−738.0	−7364.7	0.0	0.60	0.45	0.55	0.35	0.10	3,341	100	50.0

■Examination of subsidence (short period snow)

subsidence load		Endurance strength of ground	
N+W (N)	<	b×d×q (N)	
7290		27000	∴OK !

■Concrete floor panchingshere (short term wind blow up)

share force		permissible share force	
Q (N)	<	1.5×fs×t×0.9l×2(N)	
55973		94500	∴OK !

■Concrete floor bearing capacity (short term wind blow up)

share force		bearing capacity	
Q (N)	<	fc×b×0.875t/2(N)	
55973		262500	∴OK !

	X direction						
	Vertical load	t(m)	e(m)	Resistance MRx	Fall Mx		JUDGMENT
	N+W(N)	(N+W)/(b×q')	(d−t)/2	MRx(N･m)	Mx(N･m)	Mx/MRx	MR≧M
Long period load	3775.5	0.126	0.162	2,131	132.1	0.062	<1.0 OK !
Short period load	7290.0	0.121	0.164	4,235	1453.0	0.343	<1.0 OK !
Short term earthquake X	3775.5	0.063	0.194	3,768	132.1	0.035	<1.0 OK !
Short term earthquake Y	3775.5	0.063	0.194	3,768	190.6	0.051	<1.0 OK !
Short period blow down + Holizontal X	6262.8	0.104	0.173	4,120	1067.0	0.259	<1.0 OK !
Short period blow down + Holizontal Y	6262.8	0.104	0.173	4,120	1500.6	0.364	<1.0 OK !
Short period blow up+Holizontal X	0.0	0.000	0.225	3,038	−1426.0	0.469	<1.0 OK !
Short period blow up+Holizontal Y	0.0	0.000	0.225	3,038	−1859.6	0.612	<1.0 OK !

	Y direction						
	Vertical load	t(m)	e(m)	Resistance MRx	Fall Mx		JUDGMENT
	N+W(N)	(N+W)/(b×q')	(d−t)/2	MRx(N･m)	Mx(N･m)	Mx/MRx	MR≧M
Short term earthquake X	3775.5	0.084	0.258	4,012	58.5	0.015	<1.0 OK !
Short period blow down + Holizontal X	6262.8	0.139	0.230	4,481	398.1	0.089	<1.0 OK !
Short period blow up+Holizontal X	0.0	0.000	0.300	3,038	398.1	0.131	<1.0 OK !

5030 Post.

AS1664.1:1997-Aluminimum Structures Part 2: limit state design

Member	beam

T only

Alloy and tamper	Product	Tension		Compression	Shear		Bearing		Modulus of E
		Ftu	Fty	Fcy	Fsu	Fsy	Fbu	Fby	E
6063 T6	Extrusions	207	172	172	131	96	434	276	70000
				180					

Table 3.3(D) Page 20

T5,T6,T7,T8 & T9 only

Type of member stress	Intercept		Slope		Intersection	
Compression in columns and beam flanges	*Bc*	190.112849	*Dc*	0.99075936	*Cc*	78.6732591
Compression in flat plates	*Bp*	216.080333	*Dp*	1.20053227	*Cp*	73.7947145
Compression in round tubes under axial end loads	*Bt*	209.620466	*Dt*	6.71428412	*Ct*	trial and error
Compressive bending stress in solid rectangular bars	*Bbr*	317.096705	*Dbr*	2.61387132	*Cbr*	80.8753674
Compressive bending stress in round tubes	*Btb*	329.59479	*Dtb*	142.532382	*Ctb*	0.78029952
Shear stress in flat plate	*Bs*	120.834478	*Ds*	0.50203881	*Cs*	98.6818859
Ultimate strength of flat plates in compression	*k1*	0.35	*k2*	2.27		
Ultimate strength of flat plates in bending	*k1*	0.5	*k2*	2.04		

Table 3.4 (A) Page 21

Factor of safety	Normal buildings
φy	0.95
φu	0.85
φvp	0.9
φb	0.85
φcp	0.8
φw	0.9
φc	0.85
φv	0.8
φcc	see below

RHS/SHS section properties		
Effective Length (m)	2750 mm between restraints	
Height	150 mm	
Width	95 mm	
Walls side (avg if complex shape)	1.6 mm	
Walls top/bottom (average is complex shape)	5.6 mm	CM (CANTAPORT)
Ix	6621600	662.16

Table 3.4 (b) Page 21

kt	1
kc	1.12

Iy	1885900	188.59
J (Torsion constant (warp))	3402000	340.2
Zx	88290	88.29
Zy	39700	39.7
Area	1592	15.92
Radius of gyration Rx	64.49260797 mm	
Radius of gyration Ry	34.41817184 mm	

Bending capacity

3.4.15-Compresion in beams, extreme fibre, gross section - RHS and SHS page 37

Limits (N)	191.7113041	
Zc	88290	Assumed to be Zx
S1	1.792654179	
S2	2417.766287	
	mpa	
Equ-3.4.15(1): N<S1	163.4	mPa
Equ-3.4.15(2): S1<N<S	142.9393882	mPa
Equ-3.4.15(3): S2>N	1196.855281	mPa

Add tripple to one formula

3.4.12 - Compression in beams, extreme fibre, gross section single web beams bent about strong axis Page 35 **MORE ACCURATE METHOD**

limts (N)	26.5842941	Note Clause Ry=Rye Page 37 Bottom Para
Rye limit	26.5842941	Rye 103.444537

4.9 compression in single web beams and beams having sections containing tubular portions

Cb	1	Note if Ky<1 = 1
ky	1	
rye	103.4445372	
S1	-2.570688695	
S2	94.4079109	
Equ-3.4.12(1): N<S1	163.4	mPa
Equ-3.4.12(2): S1<N<S	142.9393863	mPa
Equ-3.4.12(3): S2>N	1196.855042	mPa

Add tripple to one formula

3.4.22 Compression in components of bea- flat plates with both edges supported Page 41

WEBB

NOTE AMMEND SIDE WALLS FOR ODD SHAPES

Limit (N) (h/t)	86.75
	138.8
S1	38.36639146
S2	90.53212769

Equ-3.4.22(1): N<S1	190.06
Equ-3.4.22(2): S1<N<S	140.396174
Equ-3.4.22(3): S2>N	140.5560979

Add tripple to one formula

140.37 + 88290

FLANGE

3.4.17 compression in components of beams gross section flat plates Page 38

NOTE AMMEND TO SUIT DIFFERING TOP OR BOTTOM WALLS FOR ODD SHAPES

Limit (N) (b/t)	16.39285714
H	91.8
S1	12.41378457
S2	56.24597143

Add tripple to one formula

Equ-3.4.17(1): N<S1	163.4	mPa
Equ-3.4.17(2): S1<N<S	156.9032732	mPa
Equ-3.4.17(3): S2>N	257.1171799	mPa

Compression capacity

3.4.8.1-Genreal compression

	k	1
Dc	62.79993051	
S1	0.581870399	
S2	1.241183988	
λx	0.672716031	
λy	1.260532124	
	X-X	y-y
φcc limits λ<1.2	0.858729633	0.73528825
φcc limits λ>1.2	0.674180244	0.7564745

	X-X	Y-Y	
Equ-3.4.8.1 (1) N<s1	131.8763366	112.919268	mPa
	103.5348232	116.172869	mPa
Equ-3.4.8.1 (2) s1<n<s	126.9771987	81.581349	mPa
	99.68855795	83.9319949	mPa
Equ-3.4.8.1 (3) N>s2	326.37835	79.5936167	mPa
	256.2364535	81.886989	mPa

Red through and choise the correct one.

81.58 + 1592

3.4.8.10
Compression flat plates

Webb plates		
H/t See3.4.22	86.75	
S1	23.13644439	
S2	39.37218	
Equ-3.4.17 (1) N<s1	163.4	mPa
Equ-3.4.17 (2) s1<n<s	42.02948511	mPa
Equ-3.4.17 (3) N>s2	48.5865729	mPa
Flange		
H/t See3.4.17	16.39285714	
S1	23.13644439	
S2	39.37218	
Equ-3.4.17 (1) N<s1	163.4	mPa
Equ-3.4.17 (2) s1<n<s	156.9032732	mPa
Equ-3.4.17 (3) N>s2	257.1171799	mPa

5030 Beam

AS1664.1:1997-Aluminimum Structures Part 2: limit state design

Member	beam

T only

Alloy and tamper	Product	Tension		Compression	Shear		Bearing		Modulus of E
		Ftu	Fty	Fcy	Fsu	Fsy	Fbu	Fby	E
6063 T6	Extrusions	207	172	172	131	96	434	276	70000
				180					

Table 3.3(D) Page 20

T5,T6,T7,T8 & T9 only

Type of member stress	Intercept		Slope		Intersection	
Compression in columns and beam flanges	*Bc*	190.112849	*Dc*	0.99075936	*Cc*	78.6732591
Compression in flat plates	*Bp*	216.080333	*Dp*	1.20053227	*Cp*	73.7947145
Compression in round tubes under axial end loads	*Bt*	209.620466	*Dt*	6.71428412	*Ct*	trial and error
Compressive bending stress in solid rectangular bars	*Bbr*	317.096705	*Dbr*	2.61387132	*Cbr*	80.8753674
Compressive bending stress in round tubes	*Btb*	329.59479	*Dtb*	142.532382	*Ctb*	0.78029952
Shear stress in flat plate	*Bs*	120.834478	*Ds*	0.50203881	*Cs*	98.6818859
Ultimate strength of flat plates in compression	*k1*	0.35	*k2*	2.27	[redacted]	
Ultimate strength of flat plates in bending	*k1*	0.5	*k2*	2.04		

Table 3.4 (A) Page 21

Factor of safety	Normal buildings
φy	0.95
φu	0.85
φvp	0.9
φb	0.85
φcp	0.8
φw	0.9
φc	0.85
φv	0.8
φcc	see below

RHS/SHS section properties

Effective Length (m) 3000 mm between restraints

Height 124 mm

Width 67 mm

Walls side (avg if complex shape) 1.5 mm

Walls top/bottom (average is complex shape) 3.8 mm

Ix 2317000

CM (CANTAPORT)
231.7

Table 3.4 (b) Page 21

kt	1
kc	1.12

Iy	607500		60.75
J (Torsion constant (warp))	1273000		127.3
Zx	37370		37.37
Zy	18130		18.13
Area	906		9.06
Radius of gyration Rx	50.57069451	mm	
Radius of gyration Ry	25.89459019	mm	

Bending capacity

3.4.15-Compresion in beams, extreme fibre, gross section - RHS and SHS page 37

Limits (N)	254.9687796		
Zc	37370	Assumed to be Zx	
S1	1.792654179		
S2	2417.766287		
	mpa		
Equ-3.4.15(1): N<S1	163.4	mPa	
Equ-3.4.15(2): S1<N<!	140.0804637	mPa	Add tripple to one formula
Equ-3.4.15(3): S2>N	899.916794	mPa	

3.4.12 - Compression in beams, extreme fibre, gross section single web beams bent about strong axis Page 35

MORE ACCURATE METHOD

limts (N)	30.69981192	Note Clause Ry=Rye Page 37 Bottom Para	
Rye limit	30.69981192	Rye	97.7204684

4.9 compression in single web beams and beams having sections containing tubular portions

Cb	1	Note if Ky<1 = 1	
ky	1		
rye	97.72046837		
S1	-2.570688695		
S2	94.4079109		
Equ-3.4.12(1): N<S1	163.4	mPa	
Equ-3.4.12(2): S1<N<!	140.0511658	mPa	Add tripple to one formula
Equ-3.4.12(3): S2>N	897.4709285	mPa	

3.4.22 Compression in components of bea- flat plates with both edges supported Page 41

WEBB

NOTE AMMEND SIDE WALLS FOR ODD SHAPES

Limit (N) (h/t)	77.6	
	116.4	
S1	38.36639146	
S2	90.53212769	
Equ-3.4.22(1): N<S1	190.06	
Equ-3.4.22(2): S1<N<:	154.0168614	Add tripple to one formula
Equ-3.4.22(3): S2>N	157.1294007	

140.08 × 37370

FLANGE

3.4.17 compression in components of beams gross section flat plates Page 38

NOTE AMMEND TO SUIT DIFFERING TOP OR BOTTOM WALLS FOR ODD SHAPES

Limit (N) (b/t)	16.84210526		
H	64		Add tripple to one formula
S1	12.41378457		
S2	56.24597143		
Equ-3.4.17(1): N<S1	163.4	mPa	
Equ-3.4.17(2): S1<N<:	156.169775	mPa	
Equ-3.4.17(3): S2>N	250.2588087	mPa	

Compression capacity

3.4.8.1-Genreal compression

	k	1		
Dc	62.79993051			
S1	0.581870399			
S2	1.241183988			
λx	0.935904121			
λy	1.827768697			
	X-X	y-y		
φcc limits λ<1.2	0.803460135	0.61616857		
φcc limits λ>1.2	0.711026577	0.83588762		
	X-X	Y-Y		
Equ-3.4.8.1 (1) N<s1	123.3885207	94.6258881	mPa	
	109.1933672	128.368456	mPa	Red through and choise the correct one.
Equ-3.4.8.1 (2) s1<n<:	105.524956	46.4154254	mPa	
	93.38490487	62.9666636	mPa	
Equ-3.4.8.1 (3) N>s2	157.7720474	31.7238232	mPa	
	139.621263	43.0361952	mPa	

46.415 × 906

3.4.8.10 Compression flat plates

Webb plates

H/t See3.4.22	77.6	
S1	23.13644439	
S2	39.37218	
Equ-3.4.17 (1) N<s1	163.4	mPa
Equ-3.4.17 (2) s1<n<s	56.96890871	mPa
Equ-3.4.17 (3) N>s2	54.31553092	mPa

Flange

H/t See3.4.17	16.84210526	
S1	23.13644439	
S2	39.37218	
Equ-3.4.17 (1) N<s1	163.4	mPa
Equ-3.4.17 (2) s1<n<s	156.169775	mPa
Equ-3.4.17 (3) N>s2	250.2588087	mPa

50 33
POST

AS1664.1:1997-Aluminimum Structures Part 2: limit state design

Member	beam

T only

Alloy and tamper	Product	Tension		Compression	Shear		Bearing		Modulus of E
		Ftu	Fty	Fcy	Fsu	Fsy	Fbu	Fby	E
6063 T6	Extrusions	207	172	172	131	96	434	276	70000
				180					

Table 3.3(D) Page 20

T5,T6,T7,T8 & T9 only

Type of member stress	Intercept		Slope		Intersection	
Compression in columns and beam flanges	*Bc*	190.112849	*Dc*	0.99075936	*Cc*	78.6732591
Compression in flat plates	*Bp*	216.080333	*Dp*	1.20053227	*Cp*	73.7947145
Compression in round tubes under axial end loads	*Bt*	209.620466	*Dt*	6.71428412	*Ct*	trial and error
Compressive bending stress in solid rectangular bars	*Bbr*	317.096705	*Dbr*	2.61387132	*Cbr*	80.8753674
Compressive bending stress in round tubes	*Btb*	329.59479	*Dtb*	142.532382	*Ctb*	0.78029952
Shear stress in flat plate	*Bs*	120.834478	*Ds*	0.50203881	*Cs*	98.6818859
Ultimate strength of flat plates in compression	*k1*	0.35	*k2*	2.27		
Ultimate strength of flat plates in bending	*k1*	0.5	*k2*	2.04		

Table 3.4 (A) Page 21

Factor of safety	Normal buildings
φy	0.95
φu	0.85
φvp	0.9
φb	0.85
φcp	0.8
φw	0.9
φc	0.85
φv	0.8
φcc	see below

RHS/SHS section properties

Effective Length (m)	2750 mm between restraints	
Height	150 mm	
Width	95 mm	
Walls side (avg if complex shape)	1.6 mm	
Walls top/bottom (average is complex shape)	4.4 mm	CM (CANTAPORT)
Ix	5636200	563.62

Table 3.4 (b) Page 21

kt	1
kc	1.12

Iy	1736200	173.62
J (Torsion constant (warp))	3296000	329.6
Zx	75150	75.15
Zy	36150	36.15
Area	1390	13.9
Radius of gyration Rx	63.67746967 mm	
Radius of gyration Ry	35.34211013 mm	

Bending capacity

3.4.15-Compresion in beams, extreme fibre, gross section - RHS and SHS page 37

Limits (N)	172.7818807	
Zc	75150	Assumed to be Zx
S1	1.792654179	
S2	2417.766287	
	mpa	
Equ-3.4.15(1): N<S1	163.4 mPa	
Equ-3.4.15(2): S1<N<S	143.8843872 mPa	Add tripple to one formula
Equ-3.4.15(3): S2>N	1327.97887 mPa	

178.13 x 75150

3.4.12 - Compression in beams, extreme fibre, gross section single web beams bent about strong axis Page 35 **MORE ACCURATE METHOD**

limts (N)	25.24110667	Note Clause Ry=Rye Page 37 Bottom Para
Rye limit	25.24110667	Rye 108.949264

4.9 compression in single web beams and beams having sections containing tubular portions

Cb	1	Note if Ky<1 = 1
ky	1	
rye	108.9492642	
S1	-2.570688695	
S2	94.4079109	
Equ-3.4.12(1): N<S1	163.4 mPa	
Equ-3.4.12(2): S1<N<S	143.882019 mPa	Add tripple to one formula
Equ-3.4.12(3): S2>N	1327.623817 mPa	

3.4.22 Compression in components of bea- flat plates with both edges supported Page 41

WEBB

NOTE AMMEND SIDE WALLS FOR ODD SHAPES

Limit (N) (h/t)	88.25	
	141.2	
S1	38.36639146	
S2	90.53212769	
Equ-3.4.22(1): N<S1	190.06	
Equ-3.4.22(2): S1<N<!	138.1632744	Add tripple to one formula
Equ-3.4.22(3): S2>N	138.1670424	

FLANGE

3.4.17 compression in components of beams gross section flat plates Page 38

NOTE AMMEND TO SUIT DIFFERING TOP OR BOTTOM WALLS FOR ODD SHAPES

Limit (N) (b/t)	20.86363636		
H	91.8		Add tripple to one formula
S1	12.41378457		
S2	56.24597143		
Equ-3.4.17(1): N<S1	163.4	mPa	
Equ-3.4.17(2): S1<N<!	149.6037251	mPa	
Equ-3.4.17(3): S2>N	202.0206414	mPa	

Compression capacity

3.4.8.1-Genreal compression

	k	1
Dc	62.79993051	
S1	0.581870399	
S2	1.241183988	
λx	0.681327501	
λy	1.227578407	
	X-X	y-y
φcc limits λ<1.2	0.856921225	0.74220853
φcc limits λ>1.2	0.67538585	0.75186098

	X-X	Y-Y		
Equ-3.4.8.1 (1) N<s1	131.5986167	113.982025	mPa	
	103.7199698	115.464364	mPa	Red through
Equ-3.4.8.1 (2) s1<n<!	126.2463732	83.8851586	mPa	and choise
	99.50157799	84.9760874	mPa	the correct
Equ-3.4.8.1 (3) N>s2	317.5100739	84.7141406	mPa	one.
	250.2468196	85.8158503	mPa	

8385+ 13,90

3.4.8.10 Compression flat plates

Webb plates		
H/t See3.4.22	88.25	
S1	23.13644439	
S2	39.37218	
Equ-3.4.17 (1) N<s1	163.4	mPa
Equ-3.4.17 (2) s1<n<s	39.58039927	mPa
Equ-3.4.17 (3) N>s2	47.7607388	mPa
Flange		
H/t See3.4.17	20.86363636	
S1	23.13644439	
S2	39.37218	
Equ-3.4.17 (1) N<s1	163.4	mPa
Equ-3.4.17 (2) s1<n<s	149.6037251	mPa
Equ-3.4.17 (3) N>s2	202.0206414	mPa

503) Beam

AS1664.1:1997-Aluminimum Structures Part 2: limit state design

Member	beam

T only

Alloy and tamper	Product	Tension		Compression	Shear		Bearing		Modulus of E
		Ftu	Fty	Fcy	Fsu	Fsy	Fbu	Fby	E
6063 T6	Extrusions	207	172	172	131	96	434	276	70000
				180					

Table 3.3(D) Page 20

T5,T6,T7,T8 & T9 only

Type of member stress	Intercept		Slope		Intersection	
Compression in columns and beam flanges	*Bc*	190.112849	*Dc*	0.99075936	*Cc*	78.6732591
Compression in flat plates	*Bp*	216.080333	*Dp*	1.20053227	*Cp*	73.7947145
Compression in round tubes under axial end loads	*Bt*	209.620466	*Dt*	6.71428412	*Ct*	trial and error
Compressive bending stress in solid rectangular bars	*Bbr*	317.096705	*Dbr*	2.61387132	*Cbr*	80.8753674
Compressive bending stress in round tubes	*Btb*	329.59479	*Dtb*	142.532382	*Ctb*	0.78029952
Shear stress in flat plate	*Bs*	120.834478	*Ds*	0.50203881	*Cs*	98.6818859
Ultimate strength of flat plates in compression	*k1*	0.35	*k2*	2.27		
Ultimate strength of flat plates in bending	*k1*	0.5	*k2*	2.04		

Table 3.4 (A) Page 21

Factor of safety	Normal buildings
φy	0.95
φu	0.85
φvp	0.9
φb	0.85
φcp	0.8
φw	0.9
φc	0.85
φv	0.8
φcc	see below

RHS/SHS section properties

Effective Length (m)	3300 mm between restraints	
Height	124 mm	
Width	67 mm	
Walls side (avg if complex shape)	1.5 mm	
Walls top/bottom (average is complex shape)	3.8 mm	CM (CANTAPORT)
Ix	2317000	231.7

Table 3.4 (b) Page 21

kt	1
kc	1.12

Iy	607500	60.75
J (Torsion constant (warp))	1273000	127.3
Zx	37370	37.37
Zy	18130	18.13
Area	906	9.06
Radius of gyration Rx	50.57069451 mm	
Radius of gyration Ry	25.89459019 mm	

Bending capacity

3.4.15-Compresion in beams, extreme fibre, gross section - RHS and SHS page 37

Limits (N)	280.4656576	
Zc	37370	Assumed to be Zx
S1	1.792654179	
S2	2417.766287	
	mpa	
Equ-3.4.15(1): N<S1	163.4	mPa
Equ-3.4.15(2): S1<N<!	139.030319	mPa	Add tripple to one formula
Equ-3.4.15(3): S2>N	818.1061763	mPa

[illegible]06 + 37370
138.99

3.4.12 - Compression in beams, extreme fibre, gross section single web beams bent about strong axis Page 35 **MORE ACCURATE METHOD**

limts (N) 32.20569216 Note Clause Ry=Rye Page 37 Bottom Para
Rye limit 32.20569216 Rye 102.466359
4.9 compression in single web beams and beams having sections containing tubular portions

Cb	1	Note if Ky<1 = 1
ky	1	
rye	102.4663585	
S1	-2.570688695	
S2	94.4079109	
Equ-3.4.12(1): N<S1	163.4	mPa
Equ-3.4.12(2): S1<N<!	138.9943573	mPa	Add tripple to one formula
Equ-3.4.12(3): S2>N	815.504843	mPa

3.4.22 Compression in components of bea- flat plates with both edges supported Page 41

WEBB

NOTE AMMEND SIDE WALLS FOR ODD SHAPES

Limit (N) (h/t)	77.6
	116.4
S1	38.36639146
S2	90.53212769

Equ-3.4.22(1): N<S1	190.06	
Equ-3.4.22(2): S1<N<!	154.0168614	Add tripple to one formula
Equ-3.4.22(3): S2>N	157.1294007	

FLANGE

3.4.17 compression in components of beams gross section flat plates Page 38

NOTE AMMEND TO SUIT DIFFERING TOP OR BOTTOM WALLS FOR ODD SHAPES

Limit (N) (b/t)	16.84210526	
H	64	Add tripple to one formula
S1	12.41378457	
S2	56.24597143	

Equ-3.4.17(1): N<S1	163.4	mPa
Equ-3.4.17(2): S1<N<!	156.169775	mPa
Equ-3.4.17(3): S2>N	250.2588087	mPa

Compression capacity

3.4.8.1-Genreal compression

	k	1
Dc	62.79993051	
S1	0.581870399	
S2	1.241183988	
λx	1.029494533	
λy	2.010545567	
	X-X	y-y
φcc limits λ<1.2	0.783806148	0.57778543
φcc limits λ>1.2	0.724129235	0.86147638

	X-X	Y-Y		
Equ-3.4.8.1 (1) N<s1	120.3702299	88.731334	mPa	
	111.205561	132.298158	mPa	Red through and choise the correct one.
Equ-3.4.8.1 (2) s1<n<!	98.33683986	36.89202	mPa	
	90.84973466	55.0058934	mPa	
Equ-3.4.8.1 (3) N>s2	127.2005601	24.5848291	mPa	
	117.515848	36.6559079	mPa	

906 + 36.89

3.4.8.10
Compression flat plates

Webb plates		
H/t See3.4.22	77.6	
S1	23.13644439	
S2	39.37218	
Equ-3.4.17 (1) N<s1	163.4	mPa
Equ-3.4.17 (2) s1<n<s	56.96890871	mPa
Equ-3.4.17 (3) N>s2	54.31553092	mPa
Flange		
H/t See3.4.17	16.84210526	
S1	23.13644439	
S2	39.37218	
Equ-3.4.17 (1) N<s1	163.4	mPa
Equ-3.4.17 (2) s1<n<s	156.169775	mPa
Equ-3.4.17 (3) N>s2	250.2588087	mPa

3. 5,700 SERIES

STATIC REPORT

PJR－series

5730-H23

2016. 09. 23

SankyoTateyama,Inc.

1. Material and Evaluation

①Post

Materi A6063S-T6(SS)

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N／mm2
DE8389	15.92	662.16	188.59	88.29	39.70	70000	3.44	180

Material evaluation (without support and side panel Vex＝38m/s)

Snow for short period

$\sigma b/fb+\sigma c/fc=$ 0.69 ＜1.0 OK ！

Wind blow up

$\sigma b/fb+\sigma c/fc=$ 0.70 ＜1.0 OK ！

Wind blow down

$\sigma b/fb+\sigma t/ft=$ 0.78 ＜1.0 OK ！

$2 \cdot lk/i=$ 118.5 ＜140 OK ！

②Beam

Materi A6063S-T6(SS)

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N／mm2
DE8394	10.83	267.79	73.78	43.16	22.02	70000	2.61	180

Material evaluation (without support and side panel Vex＝38m/s)

Snow for short period

$\sigma b/fb=$ 0.73 ＜1.0 OK ！

Wind blow up

$\sigma bx/fbx=$ 0.54 ＜1.0 OK ！

Wind blow down

$\sigma bx/fbx=$ 0.72 ＜1.0 OK ！

③Main frame

Materi A6063S-T6(SS)

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N／mm2
DE8580有	1.93	6.61	2.23	2.83	0.97	70000	1.08	180

Material evaluation

$\sigma b/fb=$ 0.58 ＜1.0 OK ！

④Front frame

Materi A6063S-T5

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N／mm2
DE8401	2.55	12.50	6.91	3.81	2.20	70000	1.65	132

Material evaluation

$\sigma b/fb=$ 0.34 ＜1.0 OK ！

⑤Rear frame

Materi A6063S-T5

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N／mm2
DE8404有	2.55	7.70	5.90	2.34	1.82	70000	1.52	132

Material evaluation

$\sigma b/fb=$ 0.47 ＜1.0 OK ！

⑥Rafter

Materi A6063S-T5

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N/mm2
DE8654+DE8666	1.88	0.36	3.75	0.53	1.48	70000	1.41	132

Material evaluation

σb/fb= 0.47 ＜1.0 OK !

⑦Side frame

Materi A6063S-T5

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N/mm2
DE8683+DE8412	1.65	0.40	2.00	0.32	0.93	70000	1.10	132

Material evaluation

σb/fb= 0.33 ＜1.0 OK !

⑧Corner bracket

Materi SPFH590

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N/mm2
GB8064	8.58	205.21	65.07	28.12	20.34	210000	2.75	420

Material evaluation (without support and side panel Vex=38m/s)

σbx/fb= 0.69 ＜1.0 OK !

σby/fb= 0.08 ＜1.0 OK !

⑨Main frame connecting parts

Materi A6063S-T5

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N/mm2
GB8086	2.77	5.59	1.85	2.87	1.69	70000	0.82	132

Material evaluation

τ/fs= 0.02 ＜1.0 OK !

⑩Front frame connecting parts

Materi A6063S-T5

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N/mm2
GB8084	2.62	6.94	4.75	2.95	2.26	70000	1.35	132

Material evaluation

τ/fs= 0.01 ＜1.0 OK !

⑪Rear frame connecting parts

Materi A6063S-T5

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N/mm2
GB8085	1.92	2.92	1.83	1.78	1.40	70000	0.98	132

Material evaluation

τ/fs= 0.01 ＜1.0 OK !

⑫**Roof material**

Material polycarbonat

Material performance

Material	Thickness	Length(short part)	Length(long part)	Inserting	Poisson ratio	Elasticity factor	F value
	cm	cm	cm	cm	ν	kgf/cm2	kgf/cm2
GB4107	0.18	70.3	296.2	1.89	0.3	21000	551

Material evaluation

Bending volume : Wmax= 1.82 cm

max σ x= 44.44 kgf/cm^2 < 551.0 kgf/cm^2 ∴OK !

Necessary depth of insert ΔL 0.31 cm depth or < 1.89 cm ∴OK !

⑬**Roof retainer**

Materi A6063S-T5

Material performance

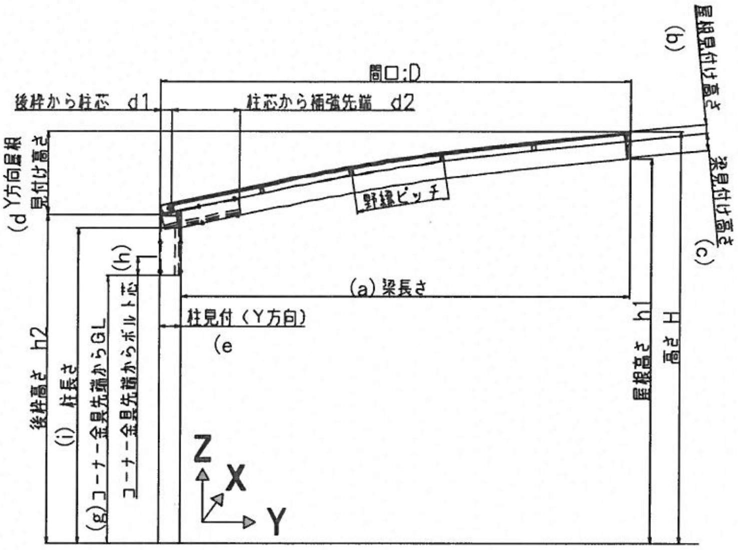
Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N／mm2
DE8411	0.79	0.03	1.84	0.08	0.72	70000	1.52	132

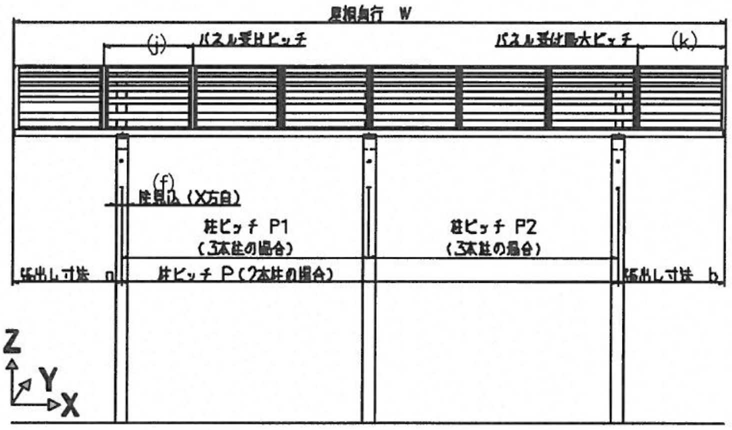
Material evaluation

σ b/fb= 0.18 <1.0 OK !

2. Carport detail

type	5730-H23
Roof projection A=	17.23 m^2
Burden projection per post=	8.61 m^2
Depth : D=	3.000 m
Roof length : W=	5.742 m
from rear frame to post core d1=	0.075 m
om post core to reinforcing end d2=	0.484 m
(a)Beam length=	2.850 m
Overhang length b=	1.221 m
(b) Roof part thickness	3.300 m
(c) Beam thickness	1.221 m
(d) Y direction roof part height=	0.065 m
(e) Post dimension(Y direction)=	0.124 m
(f) Post dimension(X direction)=	0.551 m
Overall Height(GL to Roof end) H=	0.150 m
Overall Height(GL to Beam) h1=	0.095 m
verall Height(GL to Rear frame) h2=	2.899 m
om the end of corner bracket to GL=	2.710 m
orner bracket to the center of bolts=	2.348 m
(i) Post length=	1.910 m
Post quantity=	0.130 m
(j) Rafter pitch=	2.250 m
(k) Rafter maximum span=	2
(m) Main frame pitch=	0.715 m
(s) Rafter maximum span=	0.726 m
(t) Main frame pitch=	0.585 m





3. Load design

①Vertical over load (G)

Part Weight

Roof	60.0 N/m^2
Post	42.1 N/m

②Snow over load

Post quantity	Snow area	Snow quantity	Unit weight	Short period snow period
2 posts type	General area	20 cm	30 $N/m^2/cm$	600 N/m^2

③ Wind blowing load(Vex=38m/s)

・For design of structure frame

Speed pressure $q=0.6E(Vex \cdot y)^2=$	708 N/m^2
Standard wind speed $Vex=$	38 m/s
$E=Er^2Gf=$	1.194
$Er=1.7(Zb/Z_G)^\alpha=$	0.691
Ground surface Div.	Ⅲ
Gust influence factor $Gf=$	2.5
$Zb=$	5
$Z_G=$	450
$\alpha=$	0.2
Installation period factor $y=$	0.827

・For roof material design

Average speed pressure $q'=0.6Er2(Vex \cdot y)^2=$	283 N/m^2

④Earthquake power

Earthquake power $Qi=Z \cdot Rt \cdot Ai \cdot Co \cdot Wi$

Area factor $Z=$	1.0
Vibration feature $Rt=$	1.0
Coat shear power distribution factor $Ai=$	1.0
Standard shear power factor $C_o=$	0.3

4. Preparing calculation

4-1 Carport load (For earthquake power calculation)

Roof	517	N
Post	95	N
Wi=	612	N

Earthquake power Qi=Z･Rt･Ai･Co･Wi= 183.5 N

4-2 Wind pressure power calculation (Maximum wind power pressure for 1 post)

･For design of structure frame

Wind factor		
Independent shed	10 °	
C=	0.60	(+pressure)
	-1.00	(-pressure)
	1.2	(Post flat power, side panel)

Wind pressureW=q C=	425 N/m^2	(Wind blow down)
	-708 N/m^2	(Wind blow up)
	849 N/m^2	(Flat)

･Roof material design

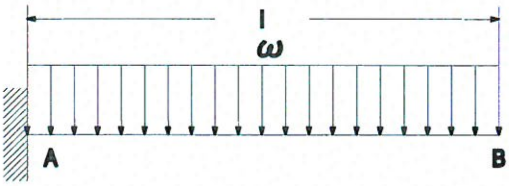
Peak with factor calculation process Gpe=	3.1	(+pressure)
	3.0	(-pressure: panel center part)
	4.0	(-pressure: panel surrounding part)

Peak wind factor Cf=	3.1	x	0.60	=	1.86
	3.0	x	-1.00	=	-3.00
	4.0	x	-1.00	=	-4.00

Wind pressure W=q' Cf=	527 N/m^2	(Wind blow down)
	-849 N/m^2	(Wind blow up)
	-1132 N/m^2	(Wind blow up)

5. Beam material examination

5-1 Beam load(without support Vex=38m/s)



Load chart

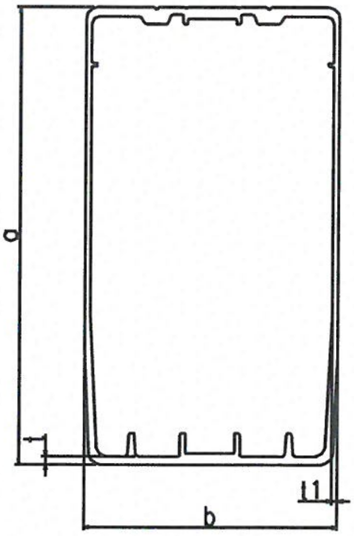
Type			
Vertical load width (m)	Total/post quantity		2.871
l (m)	D-d1-d2		2.441
Load ω(N/m)	Long period load		172.3
	Short period load		1894.9
	Short period blowing down(vertical)		1391.4
	Short period blowing up(vertical)		-1859.6
	Short period blowing down(horizontal)		133.8
	Short period earthquake(vertical)		172.3
	Short period earthquake(horizontal)		51.7
Bending moment M(N・m)	Long period load		513.2
	Short period load		5645.2
	Short period blowing down(vertical)		4145.3
	Short period blowing up(vertical)		-5540.3
	Short period blowing (horizontal)		398.5
	Short period earthquake(vertical)		513.2
	Short period earthquake(horizontal)		154.0
Maximum bending mom (N・m)	maxMx	(long period)	
		(short period)	5645.2
	maxMy	(long period)	
		(short period)	398.5
Second section mome	$Ix(cm^4)$		267.8
	$Iy(cm^4)$		73.8
Section factor	$Zx(cm^3)$		43.2
	$Zy(cm^3)$		22.0
Elasticity factor	$E(N/cm^2)$		7000000
Maximum bending stre (N/mm2)	max σx		130.8
	max σy		18.1
Vertical maximum defo	max δx	(cm)	4.49
	max δx/l	1/	128
Flat maximum deforma	max δy	(cm)	1.15
	max δy/l	1/	500

5-2 Beam permissible stress degree

Bending permissible stress degree

	Permissible stress degree for long period (N/mm2)	Permissible stress for short period(N/m3)
$b\lambda \leqq b\lambda p$	F/ν	Long period x 1.5
$b\lambda p < b\lambda \leqq b\lambda e$	$(1.0-0.5((b\lambda - b\lambda p)/(b\lambda e - b\lambda p)))F/\nu$	Long period x 1.5
$b\lambda e < b\lambda$	$(1/b\lambda^2)\cdot(F/\nu)$	Long period x 1.5

a=	12.40	cm
t=	0.49	cm
t1=	0.20	cm
b=	6.70	cm
Young's modulus factor E=	70000	N/mm^2
Shear elasticity factor of bending materialG=	27000	Nmm
Torsion fixed number of bending material=	164.6	cm^4
Second section moment around weak axis Iy=	73.775	cm^4
Section factor of bending direction Z=	43.163	cm^3
F: Standard strength (N/mm2) =	180	N/mm^2
$b\lambda = \sqrt{(My/Me)}$=	0.13	
$Me = C\sqrt{((\pi^2 EIyGJ)/lb^2)}$=	450473362	Nmm
Bending moment My=	7769340	Nmm
$C=1.75+1.05(M2/M1)+0.3(M2/M1)^2$=	1.75	
M2=	0	Nm
M1=	5540	Nm
M2/M1=	0	
lb=	584.7	mm
$b\lambda p=0.6+0.3(M2/M1)$=	0.6	
$b\lambda e=1/\sqrt{0.5}$=	1.41	



$\nu=3/2+2(b\lambda/b\lambda e)^2/3$ (its value assumes 2.17 in case more than 2.17)

ν = 1.51

$b\lambda \leqq b\lambda p$

Permissible stress degree fb: F/ν = 119.5 N/mm^2

Permissible stress degree at bend parts (strong axis)

1) Frange plate of beam <top/bottom face>

Γb :The conversion ratio = b/t・√(F/E)

Γb = 0.65

a) Γb ≦ 1.34 fb = F/1.5

b) 1.34 < Γb ≦ 2.69 fb = F − 0.248FΓb

c) 2.69 < Γb fb = 2.41 F/(Γb^2)

fb= 120.0 N/mm^2

2) Web plate of beam <side face>

Γd : The conversion ratio = d/t・√(F/E)

Γd = 2.90

a) Γd ≦ 3.29 fb = F/1.5

b) 3.29 < Γd ≦ 6.57 fb = F − 0.101FΓ

c) 6.57 < Γd fb = 14.4 F/(Γd^2)

fb= 120.0 N/mm^2

Therefore, result data is…

fbx= 119.5 N/mm^2

fbx= 179.3 N/mm^2

Permissible stress degree at bend parts (weak axis)

1) Frange plate of beam <top/bottom face>

Γb : = b/t・√(F/E)

Γb = 2.90

a) Γb ≦ 1.34 fb = F/1.5

b) 1.34 < Γb ≦ 2.69 fb = F − 0.248FΓb

c) 2.69 < Γb fb = 2.41 F/(Γb^2)

fb= 51.7 N/mm^2

2) Web plate of beam <side face>

Γd :The conversion ratio = d/t・√(F/E)

Γd = 0.65

a) Γd ≦ 3.29 fb = F/1.5

b) 3.29 < Γd ≦ 6.57 fb = F − 0.101FΓ

c) 6.57 < Γd fb = 14.4 F/(Γd^2)

fb= 120.0 N/mm^2

Therefore, result data is…

fby= 51.7 N/mm^2

fby= 77.6 N/mm^2

Section of the Beam examination

Snow for short period

M= 5645.2 N・m

σb= 130.8 N/mm^2

σb/fb= 0.73 <1.0 OK !

Wind blow down

M= 4145.3 N・m

σbx= 96.0 N/mm^2

σbx/fbx= 0.54 <1.0 OK !

Wind blow up

M= −5540.3 N・m

σbx= 128.4 N/mm^2

σbx/fbx= 0.72 <1.0 OK !

Wind blow horizontal

M= 398.5

σby= 18.1

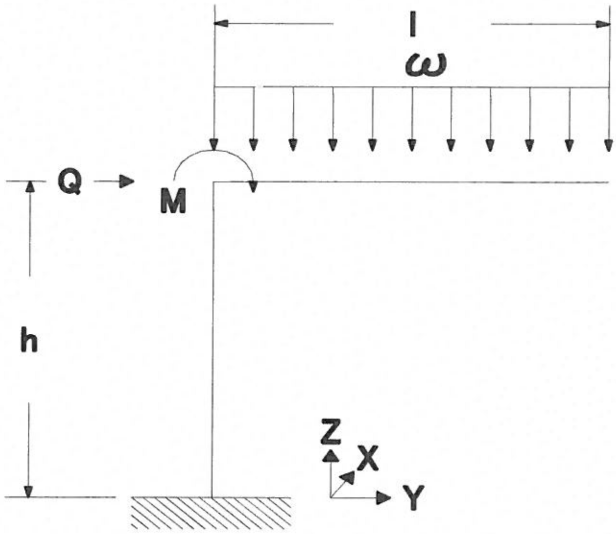
σby/fby= 0.23 <1.0 OK !

6. Post material examination

6-1 Post load

Load chart

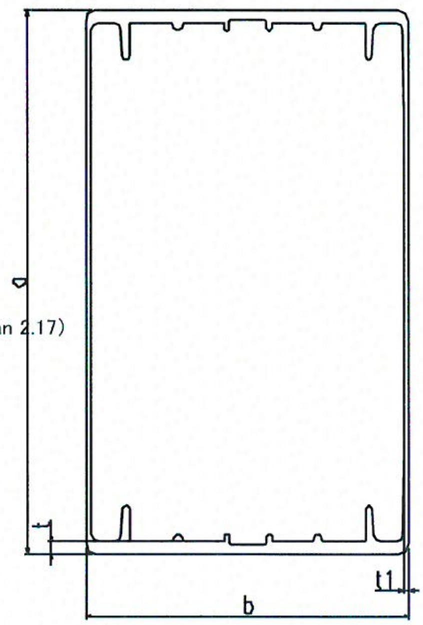
Type		
Vertical load width (m)	Total/post quantity	2.871
l (m)	D-d1	2.850
Load ω (N/m)	Long period load	172.3
	Short period load	1894.9
	Short period blowing up(vertical)	1391.4
	Short period blowing down(vertical)	−1859.6
	Short period earthquake(vertical)	172.3
Axial force by vertical load N(N)	Long period load	611.6
	Short period load	5779.4
	Short period blowing up(vertical)	4269.0
	Short period blowing down(vertical)	−5484.1
	Short period earthquake(vertical)	611.6
Flat load Q(N)	Short period wind X	637.4
	Short period wind Y	1119.4
	Short period earthquakeX、Y	155.0
Bending moment M(N·m)	Long period load	699.6
	Short period load	7695.5
	Short period blowing up(vertical)	5650.8
	Short period blowing down(vertical)	−7552.5
	Short period earthquake(vertical)	699.6
Bending moment by vertical and flat load Mx(N·m)	Short period blowing up(vertical)+WindY	8169.4
	Short period blowing down(vertical)+WindY	−10071.1
	Short period earthquake(vertical) + Earthquak	1048.4
Bending moment by flat load My(N·m)	Short period windX	1434.2
	Short period earthquakeX	348.8
Maximum bending moment(N·m)	maxMx (long period)	
	(short period)	10071.1
	maxMy (short period wind)	1434.2
	(short period earthqua	348.8
Second section moment	Ix(cm4)	662.155
	Iy(cm4)	188.59
Section factor	Zx(cm3)	88.287
	Zy(cm3)	39.70
Max. bending stress deg. σx(N/mm2)	Long period load	7.92
	Short period load	87.16
	Short period blowing up(vertical)	64.01
	Short period blowing down(vertical)	−85.54
	Short period earthquake(vertical)	7.92
	Short period blowing up(vertical)+WindY	92.53
	Short period blowing down(vertical)+WindY	−114.07
	Short period earthquake(vertical) + Earthquak	11.88
max σx(N/mm2) (uniaxial bending)	Long period	7.92
	Short period(Y direction Vertical load)	114.07
Bending stress degree σy(N/mm2)	Short period windX	36.12
	Short period earthquakeX	8.79



6-2 Post permissible stress degree

Permissible pressure stress degree

	Permissible stress degree for long period (N／mm2)	For short period(N/m3)
$c\lambda \leqq c\lambda p$	F/ν	Long period x 1.5
$c\lambda p < c\lambda \leqq c\lambda e$	$(1.0-0.5((c\lambda - c\lambda p)/(c\lambda e - c\lambda p)))F/\nu$	Long period x 1.5
$c\lambda e < c\lambda$	$(1/c\lambda^2)\cdot(F/\nu)$	Long period x 1.5



a=	15.00	cm
t=	0.56	cm
t1=	0.16	cm
b=	9.50	cm
$c\lambda=(lk/i)\sqrt{(F/\pi^2E)}$=	1.9	
lk:Buckling length(cm)＝	407.96	cm
Standard strength F(N／mm2)＝	180	N/mm^2
E:Young's modulus factor(N／mm2)＝	70000	N/mm^2
$c\lambda p$=	0.2	
$c\lambda e=1/\sqrt{0.5}$=	1.41	
$\nu=3/2+2(c\lambda/c\lambda e)2/3$	(its value assumes 2.17 in case more than 2.17)	
ν=	2.17	
H=	203.98	cm
Section second radius i(cm)＝	3.44	cm
$c\lambda e < c\lambda$		
fc=	34.8	N/mm^2

Permissible stress degree at bend parts

1) Frange plate of beam <top/bottom face>

$\Gamma d := d/t \cdot \sqrt{(F/E)}$

Γd = 0.83

a) $\Gamma d \leqq 1.34$ fb ＝ F/1.5

b) $1.34 < \Gamma d \leqq 2.69$ fb ＝ F － 0.248FΓd

c) $2.69 < \Gamma d$ fb ＝ 2.41 F/(Γd^2)

fc= 120.0 N/mm^2

2) Web plate of beam <side face>

$\Gamma d := d/t \cdot \sqrt{(F/E)}$

Γd = 4.40

a) $\Gamma d \leqq 1.34$ fb ＝ F/1.5

b) $1.34 < \Gamma d \leqq 2.69$ fb ＝ F － 0.248FΓd

c) $2.69 < \Gamma d$ fb ＝ 2.41 F/(Γd^2)

fc= 22.4 N/mm^2

Therefore, result date is･･･

fc= 22.4 N/mm^2

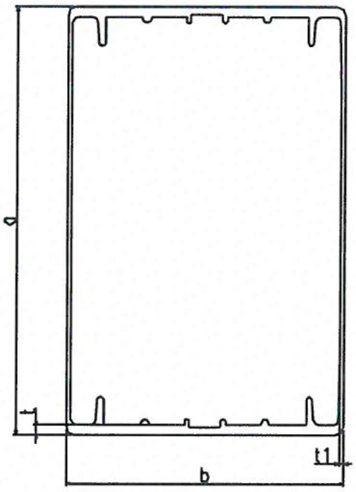
fc= 33.6 N/mm^2

6-3 Permissible stress degree at bend parts

Permissible bending stress degree

	Permissible stress degree for long period (N/mm2)	For short period(N/m3)
$b\lambda \leqq b\lambda p$	F/ν	Long period x 1.5
$b\lambda p < b\lambda \leqq b\lambda e$	$(1.0-0.5((b\lambda - b\lambda p)/(b\lambda e - b\lambda p)))F/\nu$	Long period x 1.5
$b\lambda e < b\lambda$	$(1/b\lambda^2)\cdot(F/\nu)$	Long period x 1.5

a=	15.00	cm
t=	0.56	cm
t1=	0.16	cm
b=	9.50	cm
Young's modulus factor E=	70000	N/mm^2
Shear elasticity factor of bending material G=	27000	Nmm
Torsion fixed number of bending material=	340.2	cm^4
Second section moment around weak axis Iy=	188.588	cm^4
Section factor of bending direction Z=	88.287	cm^3
F: Standard strength (N/mm2) =	180	N/mm^2
$b\lambda=\sqrt{(My/Me)}$=	0.30	
$Me=C\sqrt{((\pi^2 EIyGJ)/Ib^2)}$=	181147397	Nmm
Bending moment My=	15891660	Nmm
$C=1.75+1.05(M2/M1)+0.3(M2/M1)^2$=	1	
M2=	-7552.5	Nm
M1=	7552.5	Nm
M2/M1=	-1	
Ib=	1909.8	mm
$b\lambda p=0.6+0.3(M2/M1)$=	0.3	
$b\lambda e=1/\sqrt{0.5}$=	1.41	



$\nu=3/2+2(b\lambda/b\lambda e)^2/3$ (its value assumes 2.17 in case more than 2.17)

ν = 1.53

$b\lambda \leqq b\lambda p$

Permissble stress degree fb: F/ν = 117.7 N/mm^2

Permissible bending stress degree (strong axis)

1) Frange plate <top/bottom face>

Γb : The conversion ratio = b/t・√(F/E)

Γb = 0.83

a) Γb ≦ 1.34 fc = F/1.5

b) 1.34 < Γb ≦ 2.69 fc = F − 0.248FΓb

c) 2.69 < Γb fc = 2.41 F/(Γb2)

fb= 120.0 N/mm^2

---

2)Web plate <side face>

Γd : The conversion ratio = d/t・√(F/E)

Γd = 4.40

a) Γd ≦ 3.29 fb = F/1.5

b) 3.29 < Γd ≦ 6.57 fb = F − 0.101FΓd

c) 6.57 < Γd fb = 14.4 F/($Γd^2$)

fb= 100.0 N/mm^2

Therefore, result date is・・・

fbx= 100.0 N/mm^2

fbx= 150.0 N/mm^2

Permissible bending stress degree (weak axis)

1) Frange plate <top/bottom face>

Γb : The conversion ratio = b/t・√(F/E)

Γb= 4.40

a) Γb ≦ 1.34 fc = F/1.5

b) 1.34 < Γb ≦ 2.6 9 fc = F − 0.248FΓd

c) 2.69 < Γb fc = 2.41 F/(Γd2)

fb= 22.4 N/mm^2

---

2) Web plate <side face>

Γd : The conversion ratio = d/t・√(F/E)

Γd= 0.83

a) Γd ≦ 3.29 fb = F/1.5

b) 3.29 < Γd ≦ 6.57 fb = F − 0.101FΓd

c) 6.57 < Γd fb = 14.4 F/($Γd^2$)

fb= 120.0 N/mm^2

Therefore, result date is・・・

fby= 22.4 N/mm^2

fby= 33.6 N/mm^2

Examination of the section of the post

Short period snow load

σb= 87.2 N/mm^2

σc=N/A= 3.6 N/mm^2

σb/fb+σc/fc= 0.69 <1.0 OK !

Wind blow down

σb= 92.5 N/mm^2

σc=N/A= 2.7 N/mm^2

σb/fb+σc/fc= 0.70 <1.0 OK !

Wind blow up

σb= 114.1 N/mm^2

σt=N/A= 3.4 N/mm^2

σb/fb+σt/ft= 0.78 <1.0 OK !

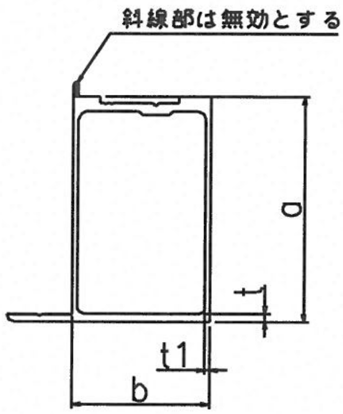
2・lk/i= 118.5 <140 OK !

7. Main Frame Bending permissible stress degree

7-1 Bending permissible stress degree

	Permissible stress degree for long period (N/mm2)	Permissible stress for short period(N/m3)
$b\lambda \leqq b\lambda p$	F/ν	Long period x 1.5
$b\lambda p < b\lambda \leqq b\lambda e$	$(1.0-0.5((b\lambda - b\lambda p)/(b\lambda e - b\lambda p)))F/\nu$	Long period x 1.5
$b\lambda e < b\lambda$	$(1/b\lambda^2)\cdot(F/\nu)$	Long period x 1.5

a=	4.60	cm
t=	0.16	cm
t1=	0.09	cm
b=	2.50	cm
Young's modulus factor E=	70000	N/mm^2
Shear elasticity factor of bending materialG=	27000	Nmm
Torsion fixed number of bending material=	3.6	cm^4
Second section moment around weak axis Iy=	2.234	cm^4
Section factor of bending direction Z=	2.829	cm^3
F:Standard strength(N/mm2)=	180	N/mm^2
$b\lambda=\sqrt{(My/Me)}$=	0.29	
$Me=C\sqrt{((\pi 2EIyGJ)/lb2)}$=	6083883	Nmm
Bending moment My=	509220	Nmm
C=	1.13	
lb=	715	mm
$b\lambda p=0.6+0.3(M2/M1)$=	0.3	
$b\lambda e=1/\sqrt{0.5}$=	1.41	



$\nu=3/2+2(b\lambda/b\lambda e)^2/3$ (its value assumes 2.17 in case more than 2.17)

ν= 1.53

$b\lambda \leqq b\lambda p$

fb= 117.8 N/mm^2

Permissible stress degree at bend parts

1) Frange plate of beam <top/bottom face>

Γb : The conversion ratio = $b/t \cdot \sqrt{(F/E)}$

Γb = 0.41

a) Γb ≦ 0.438 　fb = F/1.5

b) 0.438 < Γb ≦ 0.876 　fb = F − 0.760FΓb

c) 0.876 < Γb 　fb = 0.256 F/(Γb^2)

fb= 120.0 N/mm^2

Γb : The conversion ratio = $b/t \cdot \sqrt{(F/E)}$

Γb = 0.74

a) Γb ≦ 1.34 　fc = F/1.5

b) 1.34 < Γb ≦ 2.69 　fc = F − 0.248FΓd

c) 2.69 < Γb 　fc = 2.41 F/(Γd2)

fb= 120.0 N/mm^2

2) Wave plate of beam <side face>

Γb : The conversion ratio = $b/t \cdot \sqrt{(F/E)}$

Γd = 2.41

a) Γd ≦ 3.29 　fb = F/1.5

b) 3.29 < Γd ≦ 6.57 　fb = F − 0.101FΓ

c) 6.57 < Γd 　fb = 14.4 F/(Γd^2)

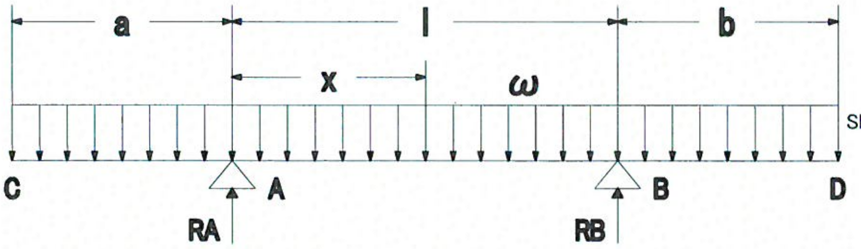
fb= 120.0 N/mm^2

Therefore, result data is…

fb= 117.8 N/mm^2

fb= 176.7 N/mm^2

7-2 Calculation of Main Frame Section



Parts Width=	0.585 m
Long period ω=	35.1 N/m
Short period load ω=	385.9 N/m
Short period blow up ω=	283.4 N/m
Short period blow down ω=	378.7 N/m
ω=	385.9 N/m
a=	1.2 m
l=	3.3 m
b=	1.2 m
x=	1.65 m
Z=	2.829 cm^3
I=	6.608 cm^4
E=	7000000 N/cm^2

W=Full-Load　M=Bend Moment
R=Anti-Power　θ =Rotation Angle
Q=Shear Power　δ =Bend

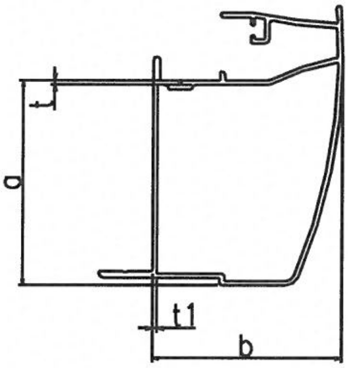
W= w(a+l+b)	=	2215.8 N
RA= $(w(a+l)^2-wb^2)/2l$	=	1107.9 N
RB= $(w(b+l)^2-wa^2)/2l$	=	1107.9 N
QA= RA−wa	=	636.7 (A,B material)
QB= wb−RB	=	−636.7 (A,B material)
MA= $-(wa^2/2)$	=	−287.7 N・m
σA= MA/Z	=	101.7 N/mm^2
MB= $-(wb^2/2)$	=	−287.7 N・m
σB= MB/Z	=	101.7 N/mm^2
MX= $RA\cdot x-w(a+x)^2/2$	=	237.6 (A,B material)
σX= MX/Z	=	84.0 N/mm^2
σb/fb	=	0.58 <1.0　OK !

8. Front frame bending permissible stress degree

8-1 Bending permissible stress degree

	Permissible stress degree for long period (N/mm2)	Permissible stress for short period(N/m3)
$b\lambda \leqq b\lambda p$	F/ν	Long period x 1.5
$b\lambda p < b\lambda \leqq b\lambda e$	$(1.0-0.5((b\lambda - b\lambda p)/(b\lambda e - b\lambda p)))F/\nu$	Long period x 1.5
$b\lambda e < b\lambda$	$(1/b\lambda^2)\cdot(F/\nu)$	Long period x 1.5

a=	4.77	cm
t=	0.10	cm
t1=	0.10	cm
b=	4.20	cm
Young's modulus factor E=	70000	N/mm^2
Shear elasticity factor of bending materialG＝	27000	Nmm(アルミ材)
Torsion fixed number of bending material＝	8.4	cm^4
Second section moment around weak axis Iy=	6.911	cm^4
Section factor of bending direction Z=	3.805	cm^3
F:Standard strength(N/mm2)＝	132	N/mm^2
$b\lambda=\sqrt{(My/Me)}$=	0.17	
$Me=C\sqrt{((\pi 2EIyGJ)/lb2)}$=	16407392	Nmm
Bending moment My=	502260	Nmm
C=	1.13	
lb=	715	mm
$b\lambda p=0.6+0.3(M2/M1)$=	0.3	
$b\lambda e=1/\sqrt{0.5}$=	1.41	



$\nu=3/2+2(b\lambda/b\lambda e)^2/3$ (its value assumes 2.17 in case more than 2.17)

ν = 1.51

$b\lambda \leqq b\lambda p$

fb= 87.4 N/mm^2

Permissible stress degree at bend parts

1) Frange plate of beam <top/bottom face>

Γb : The conversion ratio ＝ $b/t\cdot\sqrt{(F/E)}$

Γb = 1.74

a) Γb ≦ 1.34 fc ＝ F/1.5

b) 1.34 ＜ Γb ≦ 2.69 fc ＝ F － 0.248FΓd

c) 2.69 ＜ Γb fc ＝ 2.41 F/(Γd2)

fb= 75.1 N/mm^2

2) Web plate of beam <side face>

Γd ＝ $d/t\cdot\sqrt{(F/E)}$

Γd = 1.98

a) Γd ≦ 3.29 fb ＝ F/1.5

b) 3.29 ＜ Γd ≦ 6.57 fb ＝ F － 0.101FΓ

c) 6.57 ＜ Γd fb ＝ 14.4 F/(Γd^2)

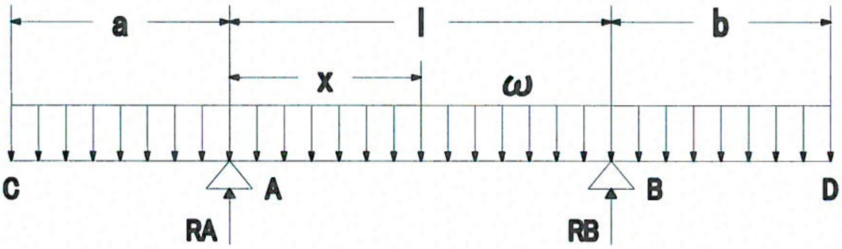
fb= 88.0 N/mm^2

Therefore, result data is…

fb= 75.1 N/mm^2

fb= 112.7 N/mm^2

8-2 Calculation of Front Frame Section



Parts Width=	0.292 m
Long period ω=	17.5 N/m
Short period load ω=	193.0 N/m
Short period blow up ω=	141.7 N/m
Short period blow down ω=	189.4 N/m
ω=	193.0 N/m
a=	1.2 m
l=	3.3 m
b=	1.2 m
x=	1.65 m
Z=	3.805 cm^3
I=	12.495 cm^4
E=	7000000 N/cm^2

W=Full-Load M=Bend Moment
R=Anti-Power θ=Rotation Angle
Q=Shear Power δ=Bend

W= w(a+l+b)	=	1107.9 N
RA= $(w(a+l)^2-wb^2)/2l$	=	554.0 N
RB= $(w(b+l)^2-wa^2)/2l$	=	554.0 N
QA= RA-wa	=	318.4 (A,B material)
QB= wb-RB	=	-318.4 (A,B material)
MA= $-(wa^2/2)$	=	-143.8 N・m
σA= MA/Z	=	37.8 N/mm^2
MB= $-(wb^2/2)$	=	-143.8 N・m
σB= MB/Z	=	37.8 N/mm^2
MX= $RA\cdot x-w(a+x)^2/2$	=	118.8 (A,B material)
σX= MX/Z	=	31.2 N/mm^2
σb/fb	=	0.34 ＜1.0 OK !

9. **Bending permissible stress degree at rear frame**

9-1 Calculation method of effective section

Γb = b/t· √(F/E)= 0.438 Therefore…

b/t = 0.438/√(F/E)= 10.09

Effective Depth

t2= 1.70 mm

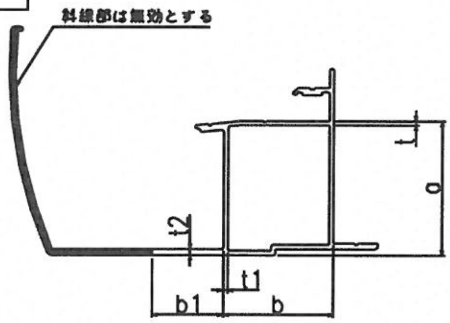
b1= 17.15 mm

9-2. Bending permissible stress degree at rear frame

Bending permissible stress degree

	Permissible stress degree for long period (N/mm2)	Permissible stress for short period(N/m3)
bλ≦bλp	F/ν	Long period x 1.5
bλp<bλ≦bλe	(1.0−0.5((bλ−bλp)/(bλe−bλp)))F/ν	Long period x 1.5
bλe<bλ	(1/bλ²)·(F/ν)	Long period x 1.5

a=	3.82	cm
t=	0.12	cm
t1=	0.12	cm
b=	2.95	cm



Young's modulus factor E=	70000	N/mm^2
Shear elasticity factor of bending materialG=	27000	Nmm
Torsion fixed number of bending material=	4.0	cm^4
Second section moment around weak axis Iy=	7.702	cm^4
Section factor of bending direction Z=	2.344	cm^3
F:Standard strength(N/mm2)=	132	N/mm^2
bλ=√(My/Me)=	0.16	
Me=C√((π²EIyGJ)/lb²)=	12025195	Nmm
Bending moment My=	309408	Nmm
C=	1.13	
lb=	715	mm
bλp=0.6+0.3(M2/M1)=	0.3	
bλe=1/√0.5=	1.41	

$\nu = 3/2 + 2(b\lambda / b\lambda e)^2/3$ (its value assumes 2.17 in case more than 2.17)

ν= 1.51

bλ≦bλp

fb= 87.5 N/mm^2

Permissible stress degree at bend parts

1) Frange plate of beam <top/bottom face>

Γb : The conversion ratio = b/t · √(F/E)

Γb = 0.98

a) Γb ≦ 1.34 fc = F/1.5

b) 1.34 < Γb ≦ 2.69 fc = F − 0.248FΓd

c) 2.69 < Γb fc = 2.41 F/(Γd2)

fb= 88.0 N/mm^2

2) Web plate of beam <side face>

Γd = d/t · √(F/E)

Γd = 1.30

a) Γd ≦ 3.29 fb = F/1.5

b) 3.29 < Γd ≦ 6.57 fb = F − 0.101FΓ

c) 6.57 < Γd fb = 14.4 F/(Γd²)

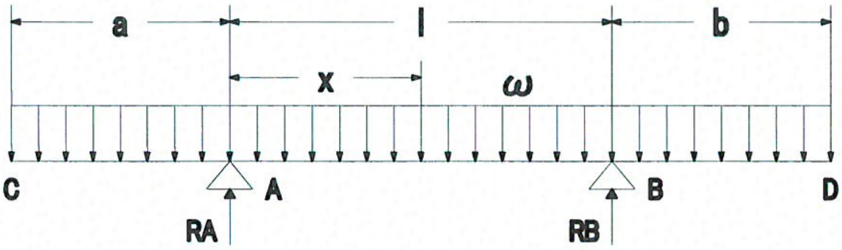
fb= 88.0 N/mm^2

Therefore, result data is…

fb= 87.5 N/mm^2

fb= 131.2 N/mm^2

9-3 Calculation of Rear Frame Section



Parts Width=	0.292	m
Long period ω=	17.5	N/m
Short period load ω=	193.0	N/m
Short period blow up ω=	141.7	N/m
Short period blow down ω=	189.4	N/m
ω=	193.0	N/m
a=	1.2	m
l=	3.3	m
b=	1.2	m
x=	1.65	m
Z=	2.344	cm^3
I=	7.702	cm^4
E=	7000000	N/cm^2

W=Full-Load M=Bend Moment
R=Anti-Power θ=Rotation Angle
Q=Shear Power δ=Bend

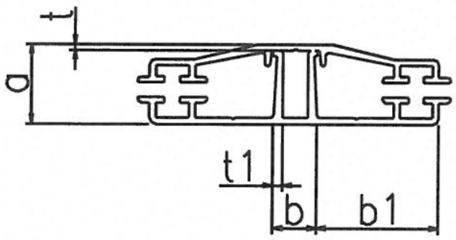
W= w(a+l+b)	=	1107.9 N
RA= $(w(a+l)^2-wb^2)/2l$	=	554.0 N
RB= $(w(b+l)^2-wa^2)/2l$	=	554.0 N
QA= RA-wa	=	318.4 (A,B material)
QB= wb-RB	=	-318.4 (A,B material)
MA= $-(wa^2/2)$	=	-143.8 N·m
σA= MA/Z	=	61.4 N/mm^2
MB= $-(wb^2/2)$	=	-143.8 N·m
σB= MB/Z	=	61.4 N/mm^2
MX= $RA\cdot x-w(a+x)^2/2$	=	118.8 (A,B material)
σX= MX/Z	=	50.7 N/mm^2

σb/fb = 0.47 $<$1.0 OK !

10. Rafter / Roof retainer bending permissible stress degree

10-1 Bending permissible stress degree

a=	1.30	cm
t=	0.10	cm
t1=	0.17	cm
b=	0.72	cm
b1=	1.99	cm
Young's modulus factor E=	70000	N/mm^2
Shear elasticity factor of bending materialG=	27000	Nmm
Second section moment around weak axis Iy=	0.364	cm^4
Section factor of bending direction Z=	0.529	cm^3
F:Standard strength(N／mm2)＝	132	N/mm^2



Therefore…

fb＝ 88.0 N/mm^2

Permissible stress degree at bend parts

Frange plate of beam 〈top/bottom face〉

Γb ： The conversion ratio ＝ b/t ・ √(F/E)

Γb ＝ 0.86

a) Γb ≦ 0.438 　　fb ＝ F/1.5

b) 0.438 ＜ Γb ≦ 0.876 　　fb ＝ F － 0.760FΓb

c) 0.876 ＜ Γb 　　fb ＝ 0.256 F/(Γb2)

fb= 45.3 N/mm^2

Therefore…

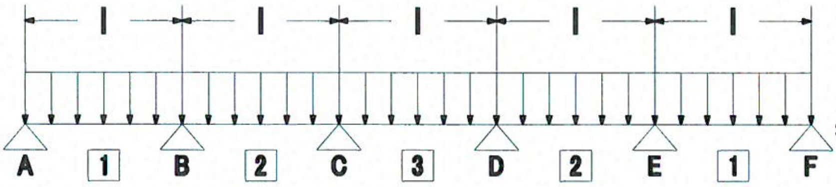
fb= 45.3 N/mm^2

fb= 68.0 N/mm^2

10-2 Calculation of Rafter / Roof retainer section

Parts Width= 0.715 m

l= 0.585 m



Long period ω=	42.9 N/m
Short period load ω=	471.9 N/m
Short period blow up ω=	346.5 N/m
Short period blow down ω=	-463.1 N/m
ω=	471.9 N/m
Z=	0.529 cm^3
I=	0.364 cm^4
E=	7000000 N/cm^2

W=Full-Load M=Bend Moment
R=Anti-Power θ=Rotation Angle
Q=Shear Power δ=Bend

	ωl	=	275.9 N
RA=	0.395 * ωl	=	109.0 N
RB=	1.131 * ωl	=	312.1 N
RC=	0.974 * ωl	=	268.7 N
RD=	0.974 * ωl	=	268.7 N
RE=	1.131 * ωl	=	312.1 N
RF=	0.395 * ωl	=	109.0 N
Rmax=			312.1 N
MB=	-0.105 * ωl^2	=	-16.9 N・m
MC=	-0.079 * ωl^2	=	-12.7 N・m
MD=	-0.079 * ωl^2	=	-12.7 N・m
ME=	-0.105 * ωl^2	=	-16.9 N・m
M1=	0.078 * ωl^2	=	12.6 N・m
M2=	0.033 * ωl^2	=	5.3 N・m
M3=	0.046 * ωl^2	=	7.4 N・m
σX=	MX/Z	=	32.0 N/mm^2
	σb/fb	=	0.47 $<$1.0 OK !

11. Side frame bending permissible stress degree

11-1 Calculation method of effective section

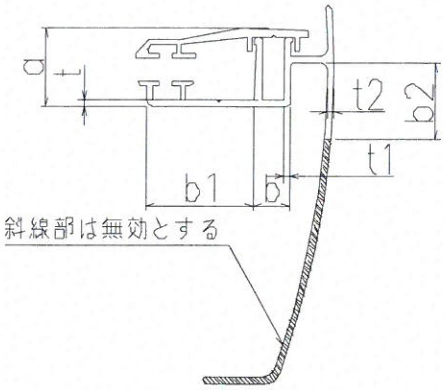
$\Gamma b = b/t \cdot \sqrt{(F/E)} = 0.438$ Therefore…

$b/t = 0.438/\sqrt{(F/E)} = 10.09$

Effective Depth

t2= 1.20 mm

b2= 12.10 mm



11-2 Bending permissible stress degree

a=	1.30 cm
t=	0.11 cm
t1=	0.17 cm
b=	0.72 cm
b1=	1.99 cm

Young's modulus factor E= 70000 N/mm^2

ear elasticity factor of bending materialG= 27000 Nmm

cond section moment around weak axis Iy= 2 cm^4

Section factor of bending direction Z= 0.324 cm^3

F:Standard strength(N／mm2)= 132 N/mm^2

Therefore…

fb= 88.0 N/mm^2

Permissible stress degree at bend parts

Frange plate of beam <top/bottom face>

Γb : The conversion ratio $= b/t \cdot \sqrt{(F/E)}$

$\Gamma b =$ 0.79

a) $\Gamma b \leqq 0.438$ $fb = F/1.5$

b) $0.438 < \Gamma b \leqq 0.876$ $fb = F - 0.760F\Gamma b$

c) $0.876 < \Gamma b$ $fb = 0.256 F/(\Gamma b2)$

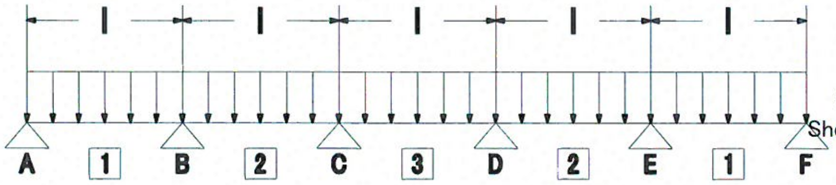
fb= 53.2 N/mm^2

Therefore…

fb= 53.2 N/mm^2

fb= 79.8 N/mm^2

11-3 Calculation of Side frame secton



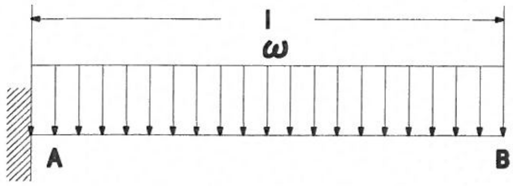
Parts Width=	0.363 m
l=	0.585 m
Long period ω=	21.8 N/m
Short period load ω=	239.6 N/m
Short period blow up ω=	175.9 N/m
Short period blow down ω=	-235.1 N/m
ω=	239.6 N/m
Z=	0.324 cm^3
I=	0.399 cm^4
E=	7000000 N/cm^2

W=Full-Load M=Bend Moment
R=Anti-Power θ=Rotation Angle
Q=Shear Power δ=Bend

	ωl	=	140.1 N
RA=	0.395 ＊ ωl	=	55.3 N
RB=	1.131 ＊ ωl	=	158.4 N
RC=	0.974 ＊ ωl	=	136.4 N
RD=	0.974 ＊ ωl	=	136.4 N
RE=	1.131 ＊ ωl	=	158.4 N
RF=	0.395 ＊ ωl	=	55.3 N
Rmax=			158.4 N
MB=	-0.105 ＊ ωl^2	=	-8.6 N・m
MC=	-0.079 ＊ ωl^2	=	-6.5 N・m
MD=	-0.079 ＊ ωl^2	=	-6.5 N・m
ME=	-0.105 ＊ ωl^2	=	-8.6 N・m
M1=	0.078 ＊ ωl^2	=	6.4 N・m
M2=	0.033 ＊ ωl^2	=	2.7 N・m
M3=	0.046 ＊ ωl^2	=	3.8 N・m
σX=	MX/Z	=	26.5 N/mm^2
	σb/fb	=	0.33 ＜1.0 OK !

12. Corner bracket examination

12-1 Beam load



Load chart

Type			
Vertical load width (m)	Total/post quantity		2.871
l (m)	D-d1-d2		2.925
Load	Long period load		172.3
ω(N/m)	Short period load		1894.9
	Short period blowing up(vertical)		1391.4
	Short period blowing up(vertical)		-1687.4
	Short period blowing down(horizontal)		160.5
	Short period earthquake(vertical)		172.3
	Short period earthquake(horizontal)		51.7
	Long period load		736.9
	Short period load		8105.9
Bending moment	Short period blowing down(vertical)		5952.2
M(N·m)	Short period blowing up(vertical)		-7218.3
	Short period blowing (horizontal)		686.6
	Short period earthquake(vertical)		736.9
	Short period earthquake(horizontal)		221.1
Maximum bending momen	maxMx	(long period)	
(N·m)		(short period)	8105.9
	maxMy	(long period)	
		(short period)	686.6
Second section moment	$I_x(cm^4)$		267.8
	$I_y(cm^4)$		73.8
Section factor	$Z_x(cm^3)$		43.2
	$Z_y(cm^3)$		22.0
Elasticity factor	$E(N/cm^2)$		21000000
Maximum bending stress degree	max σx		187.8
(N/mm2)	max σy		31.2
Vertical maximum deformation quantity	max δx	(cm)	3.08
	max δx/l	1/	186
Flat maximum deformation quantity	max δy	(cm)	0.95
	max δy/l	1/	606

12-2 Calculation of Corner bracket Section

Material	Second section moment		Section factor	
	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)
GB8064	205.211	65.073	28.119	20.335

fb= 420 N/mm^2
Mx= 8105.9 N·m
My= 686.6 N·m

σbx= 288.3 N/mm^2
σby= 33.8 N/mm^2

σbx/fb= 0.69 <1.0 OK !
σby/fb= 0.08 <1.0 OK !

13. Examination of main frame connecting part

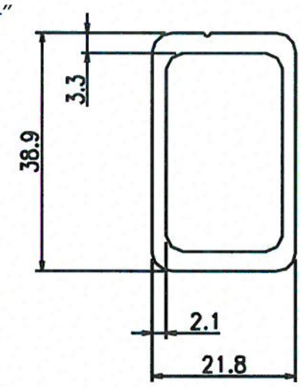
13-1 Calculation of Load

・Anti-Power of rafter

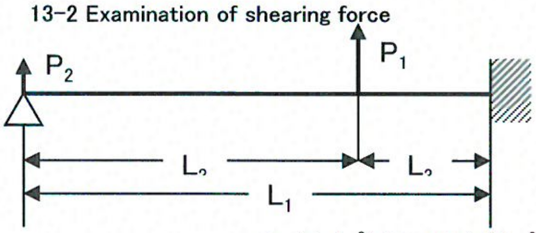
P_1= P1= 312.1 N ←from "Calculation of rafter"

・Anti-Power of connecting rafter

P_2= P2= 156.0 N ←(Anti-Power of rafter)/2



13-2 Examination of shearing force



L_1(m)	1.22
L_2(m)	0.715
L_3(m)	0.51
A(mm^2)	276.8
fs(N/mm^2)	76.2

$Q= (P_1 \cdot L_3^2) \cdot (3L_2+2L_3)/(2L_1^3)+P_2$ より

Q= 225.3 N

τ =Q/A= 0.81 N/mm^2

τ /fs= 0.02 <1.0 OK !

14. Examination of front frame connecting part

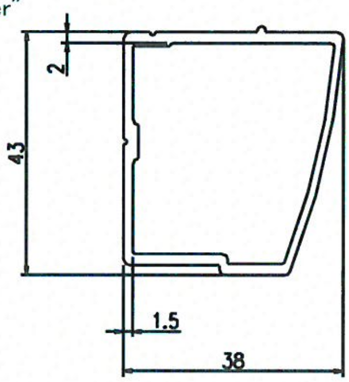
14-1 Calculation of Load

・Anti-Power of rafter

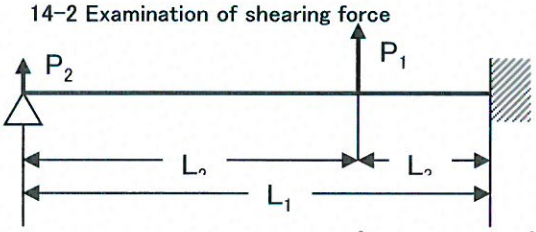
P_1= P1= 109.0 N ←from "Calculation of rafter"

・Anti-Power of connecting rafter

P2= 54.5 N ←(Anti-Power of rafter)/2



14-2 Examination of shearing force



L_1(m)	1.22
L_2(m)	0.715
L_3(m)	0.51
A(mm^2)	261.6
fs(N/mm^2)	76.2

$Q= (P_1 \cdot L_3^2) \cdot (3L_2+2L_3)/(2L_1^3)+P_2$ より

Q= 78.7 N

τ =Q/A= 0.30 N/mm^2

τ /fs= 0.01 <1.0 OK !

15. Examination of gutter connecting part

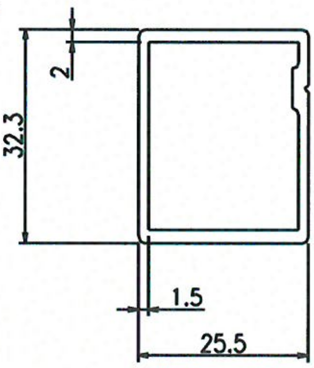
15-1 Calculation of Load

・Anti-Power of rafter

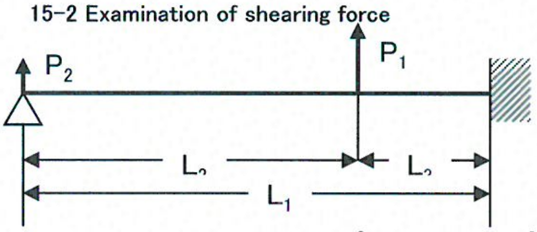
P_1= P1= 109.0 N ←from "Calculation of rafter"

・Anti-Power of connecting rafter

P_2= P2= 54.5 N ←(Anti-Power of rafter)/2



15-2 Examination of shearing force



L_1(m)	1.22
L_2(m)	0.715
L_3(m)	0.51
A(mm^2)	192.1
fs(N/mm^2)	76.2

$Q= (P_1 \cdot L_3^2) \cdot (3L_2+2L_3)/(2L_1^3)+P_2$ より

Q= 78.7 N

τ =Q/A= 0.41 N/mm^2

τ /fs= 0.01 <1.0 OK !

16. Examination of main frame and beam connection

16-1 Examination of screw pull-out force

・Pull-out force/screw

T= 554.0 N

・Stretching permissible stress

$ft = 2.1 \cdot \beta \cdot ((d^2 - d_1^2)/(P \cdot d^4))^{0.5} \cdot t^{1.2} \cdot Ft \cdot 1.5$

= 172.7 N/mm^2

・Effective section

A= 11.2 mm^2

σt= 49.4 N/mm^2

$\sigma t/ft$= 0.29 <1.0 OK !

β	0.6
Screw diameter	5
Core diameter	3.78
Pitch	0.8
t(Thickness)	4.6
Ft(Standard strength)	100

16-2 Examination of Beam bending stress

・Beam top face bending moment

M= 3108.1 N・mm

Z= 58.6 mm^3

σb= 53.1 N/mm^2

$\sigma b/fb$= 0.26 <1.0 OK !

b(Beam depth dimension)	61
t(Thickness)	2.4
a(load point)	18.5

17. Examination of rafter and main frame connection

17-1 Examination of screw pull-out force

・Pull-out force/screw

T= 312.1 N

・Stretching permissible stress

$ft = 2.1 \cdot \beta \cdot ((d^2 - d_1^2)/(P \cdot d^4))^{0.5} \cdot t^{1.2} \cdot Ft \cdot 1.5$

= 93.7 N/mm^2

・Effective section

A= 6.7 mm^2

σt= 46.3 N/mm^2

$\sigma t/ft$= 0.49 <1.0 OK !

β	0.6
Screw diameter	4
Core diameter	2.93
Pitch	0.7
t(Thickness)	2.1
Ft(Standard strength)	100

17-2 Examination of Main frame bending stress

・Main frame top face bending moment

M= 898.7 N・mm

Z= 22.0 mm^3

σb= 40.8 N/mm^2

$\sigma b/fb$= 0.20 <1.0 OK !

b(Beam depth dimension)	25
t(Thickness) center	2.3
a(load point)	10

18. Examination of Roof material

18-1 Examination of Bending volume

Poisson ratio : ν =	0.3	Bending volume : Wmax	
Distribution Load : P=	0.0116 kgf/cm^2	$A \cdot Wmax^3 + B \cdot Wmax + C = 0$	
E: Young's modulus factor =	21000 kgf/cm^2		
Thickness : h=	0.18 cm	$A = (4\nu/a^2b^2 + (3-\nu^2)\cdot(1/a^4+1/b^4))/h^3$	
Short edge a=	70.3 cm	=	2096.9
Long edge b=	296.2 cm	$B = (4/3)\cdot(1/a^2+1/b^2)^2/h$	
		=	33.8
		$C = -256(1-\nu^2)P/(\pi^6 E h^4)$	
		=	-12701.0

Bending volume : Wmax= 1.82 cm

18-2 Bending stress degree

$\max\sigma x = ((\pi^2 \cdot E \cdot Wmax)/(8\cdot(1-\nu^2)))\cdot((2-\nu^2)Wmax+4h)/a^{2+}(\nu(Wmax+4h))/b2)$

= 44.4 kgf/cm^2 < 551 kgf/cm^2 ∴OK !

18-3 Necessary depth of insert

Necessary depth of insert ΔL

ΔL = ΔX x SF + Δl

However, ΔX : The gap volume by a bend

= (lx - b) / 2

lx : Arc length while bending

= 2 x sin-1[(b/2)/r] x r

r : Radius rate while bending

= (b2+4δ2)/8δ

δ : Bending rate of Polycarbonate = Wmax (cm)

b : Length of short (cm)

Δl : The volume of expansion and contraction at temperature

= K · Δt · b/2

K : Line coefficient of expansion (cm/cm/℃)

Δt : Temperature differency at 50℃

SF : Safety ratio SF=3. 0

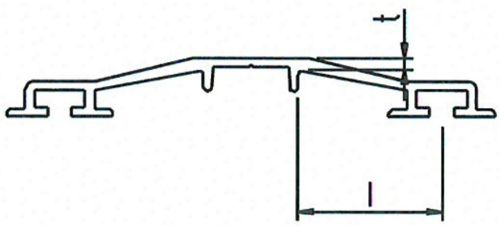
r=	340.4
lx=	70.43 cm
ΔX=	0.06 cm
K=	0.00007 cm/cm/℃
Δt =	50 ℃
SF=	3.0
Δl=	0.12 cm

Therefore…

ΔL= 0.31 cm depth or more < 1.89 cm ∴OK !

19. Examination of Roof retainer

Rafter pitch=	715 mm
Supporting length l=	15 mm
Material thickness t=	1.2 mm
F: Standard strength=	132 N/mm^2
Blow up load ω=	383.4 N/m
Load $P=\omega b$=	3.834 N
$M=P\cdot l$=	5.8 Ncm
Section factor $Z=bt^2/6$=	0.002 cm^3
$\sigma b=M/Z$=	24.0 N/mm^2



$\sigma b/fb$= 0.18 <1.0 OK !

20. Ground Foundation

20-1 Without concrete floor

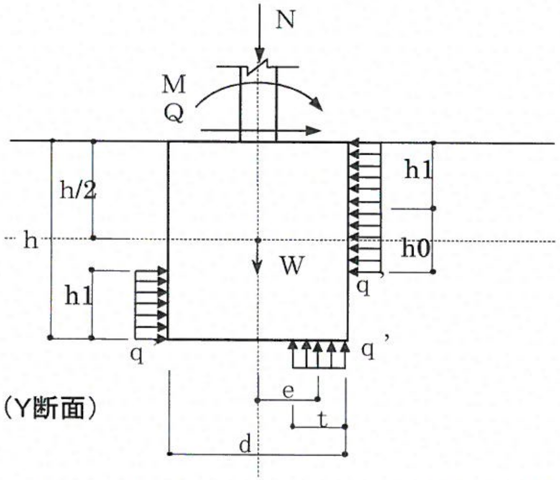
Resistance moment

M_R=(N+W)×e+q's×b×h_1×(h_1+h_0)

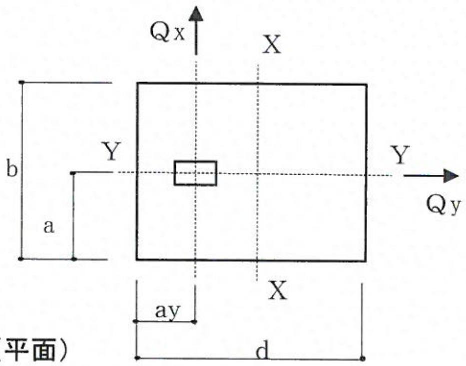
Resistance moment

M=M'+Q*(h/2)−N x (d/2−a)

Base Foundation	
Lateral Pressure	0.5
b=	0.90 m
d=	1.35 m
h=	0.55 m
ay=	0.30 m
ax=	0.45 m
Endurance strength of ground Fe=	100 KN/m²
Short Term Permissible Endurance strength of ground q=	200 KN/m²
No line concrete Volume weight	22.5 KN/m³



(Y断面)



(平面)

	Spindle Force(N)	Shear power(N)		Moment(Nm)		Foundation size(m)				Base Weight	Endurance strength of ground	Lateral Pressure
	N	Qx	Qy	M'x	M'y	b	d	h	a	W(N)	q'(kN/m2)	's(kN/m2)=0.5
Long period load	611.6	0.0	0.0	699.6	0.0	0.90	1.35	0.55	0.30	15,036	100	50.0
Short period load	5779.4	0.0	0.0	7695.5	0.0	0.90	1.35	0.55	0.30	15,036	200	100.0
Short term earthquake X	611.6	155.0	0.0	699.6	348.8	0.90	1.35	0.55	0.30	15,036	200	100.0
Short term earthquake Y	611.6	0.0	155.0	1048.4	0.0	0.90	1.35	0.55	0.30	15,036	200	100.0
Short period blow down + Holizontal	4269.0	637.4	0.0	5650.8	1434.2	0.90	1.35	0.55	0.30	15,036	200	100.0
Short period blow down + Holizontal	4269.0	0.0	1119.4	8169.4	0.0	0.90	1.35	0.55	0.30	15,036	200	100.0
Short period blow up+Holizontal X	−5484.1	637.4	0.0	−7552.5	1434.2	0.90	1.35	0.55	0.30	15,036	200	100.0
Short period blow up+Holizontal Y	−5484.1	0.0	−1119.4	−10071.1	0.0	0.90	1.35	0.55	0.30	15,036	200	100.0

■Examination of subsidence (short period snow)

subsidence load		Endurance strength of ground	
N+W (N)	<	b×d×q (N)	
20815		243000	∴OK !

■Examination of uplift (short period blow up)

uplift load		Base weight	
N (N)	<	b×d×h×γ(N)	
5484		15036	∴OK !

	X direction							
	t(m)	e(m)	h0(m)	h1(m)	Resistance MRx	Fall Mx		JUDGMENT
	(N+W)/(b×q')	(d−t)/2	Qy/(b×q's)	(h−h0)/2	MRx(N·m)	Mx(N·m)	Mx/MRx	MR≧M
Long period load	0.174	0.588	0.000	0.275	12,605	470.3	0.037	<1.0 OK !
Short period load	0.116	0.617	0.000	0.275	19,653	5528.2	0.281	<1.0 OK !
Short term earthquake X	0.087	0.632	0.000	0.275	16,688	470.3	0.028	<1.0 OK !
Short term earthquake Y	0.087	0.632	0.002	0.274	16,688	861.7	0.052	<1.0 OK !
Short period blow down + Holizontal X	0.107	0.621	0.000	0.275	18,802	4050.0	0.215	<1.0 OK !
Short period blow down + Holizontal Y	0.107	0.621	0.012	0.269	18,798	6876.4	0.366	<1.0 OK !
Short period blow up+Holizontal X	0.053	0.648	0.000	0.275	13,000	−5495.9	0.423	<1.0 OK !
Short period blow up+Holizontal Y	0.053	0.648	0.012	0.269	12,997	−8322.4	0.640	<1.0 OK !

	Y direction							
	t(m)	e(m)	h0(m)	h1(m)	Resistance MRx	Fall Mx		JUDGMENT
	(N+W)/(d×q')	(b−t)/2	Qx/(d×q's)	(h−h0)/2	MRy(N·m)	My(N·m)	My/Mry	MR≧M
Short term earthquake X	0.058	0.421	0.001	0.274	16,797	391.5	0.023	<1.0 OK !
Short period blow down + Holizontal X	0.071	0.414	0.005	0.273	18,206	1609.5	0.088	<1.0 OK !
Short period blow up+Holizontal X	0.035	0.432	0.005	0.273	14,338	1609.5	0.112	<1.0 OK !

21-1 With concrete floor

Resistance moment

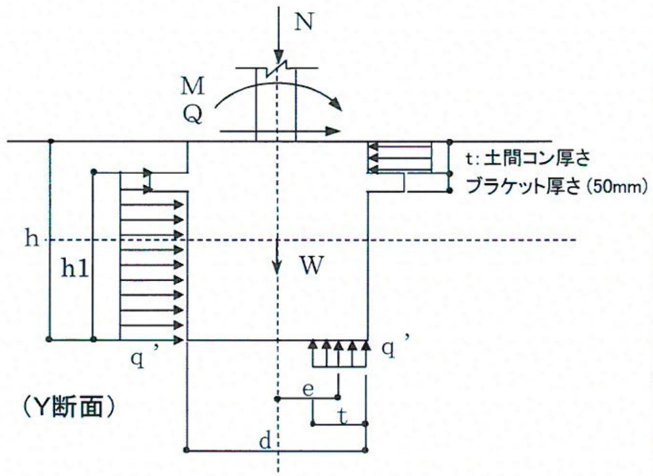
M_R=(N+W)×e+q's×b×h_1×h_1/2

Fall moment

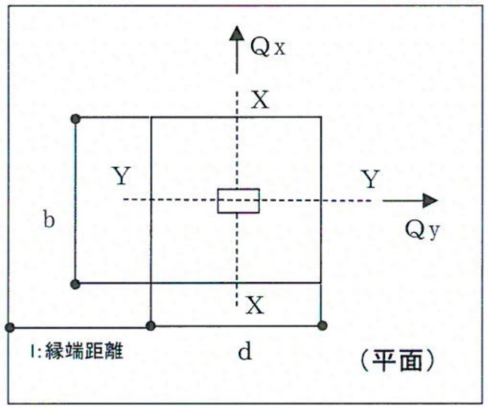
M=M'+Q*(h/2)

Base Foundation

Lateral Pressure	**0.5**	
b=	0.70	m
d=	0.45	m
h=	0.55	m
h_1=	0.45	m
l=	0.40	m
Concrete floor thickness t=	0.10	m
Endurance strength of ground Fe=	50	KN/m²
Short Term Permissible Endurance strength of ground q=	100	KN/m²
No line concrete Volume weight γ=	22.5	KN/m³
Concrete standard strength Fc=	15000	KN/m³



(Y断面)



(平面)

	Spindle Force(N)	Shear power(N)		Moment(Nm)		Foundation size(m)					Base Weight	Endurance strength of ground	Lateral Pressure
	N	Qx	Qy	M'x	M'y	b	d	h	nd part lengt	oor thicknes	W(N)	q'(kN/m2)	's(kN/m2)=0.5c
Long period load	611.6	0.0	0.0	699.6	0.0	0.70	0.45	0.55	0.40	0.10	3,898	50	25.0
Short period load	5779.4	0.0	0.0	7695.5	0.0	0.70	0.45	0.55	0.40	0.10	3,898	100	50.0
Short term earthquake X	611.6	155.0	0.0	699.6	348.8	0.70	0.45	0.55	0.40	0.10	3,898	100	50.0
Short term earthquake Y	611.6	0.0	155.0	1048.4	0.0	0.70	0.45	0.55	0.40	0.10	3,898	100	50.0
Short period blow down + Holizontal X	4269.0	637.4	0.0	5650.8	1434.2	0.70	0.45	0.55	0.40	0.10	3,898	100	50.0
Short period blow down + Holizontal Y	4269.0	0.0	1119.4	8169.4	0.0	0.70	0.45	0.55	0.40	0.10	3,898	100	50.0
Short period blow up+Holizontal X	-5484.1	637.4	0.0	-7552.5	1434.2	0.70	0.45	0.55	0.40	0.10	3,898	100	50.0
Short period blow up+Holizontal Y	-5484.1	0.0	-1119.4	-10071.1	0.0	0.70	0.45	0.55	0.40	0.10	3,898	100	50.0

■Examination of subsidence (short period snow)

subsidence load		Endurance strength of ground	
N+W (N)	<	b×d×q (N)	
9677		31500	∴OK !

■Concrete floor panchingshere (short term wind blow up)

share force		permissible share force	
Q (N)	<	1.5×fs×t×0.9l×2(N)	
76652		108000	∴OK !

■Concrete floor bearing capacity (short term wind blow up)

share force		bearing capacity	
Q (N)	<	fc×b×0.875t/2(N)	
76652		306250	∴OK !

	X direction						
	Vertical load	t(m)	e(m)	Resistance MRx	Fall Mx		JUDGMENT
	N+W(N)	(N+W)/(b×q')	(d-t)/2	MRx(N·m)	Mx(N·m)	Mx/MRx	MR≧M
Long period load	4509.7	0.129	0.161	2,496	174.9	0.070	<1.0 OK !
Short period load	9677.5	0.138	0.156	5,052	1923.9	0.381	<1.0 OK !
Short term earthquake X	4509.7	0.064	0.193	4,413	174.9	0.040	<1.0 OK !
Short term earthquake Y	4509.7	0.064	0.193	4,413	266.0	0.060	<1.0 OK !
Short period blow down + Holizontal X	8167.1	0.117	0.167	4,905	1412.7	0.288	<1.0 OK !
Short period blow down + Holizontal Y	8167.1	0.117	0.167	4,905	2070.3	0.422	<1.0 OK !
Short period blow up+Holizontal X	0.0	0.000	0.225	3,544	-1888.1	0.533	<1.0 OK !
Short period blow up+Holizontal Y	0.0	0.000	0.225	3,544	-2545.8	0.718	<1.0 OK !

	Y direction						
	Vertical load	t(m)	e(m)	Resistance MRx	Fall Mx		JUDGMENT
	N+W(N)	(N+W)/(b×q')	(d-t)/2	MRx(N·m)	Mx(N·m)	Mx/MRx	MR≧M
Short term earthquake X	4509.7	0.100	0.300	3,631	91.1	0.025	<1.0 OK !
Short period blow down + Holizontal X	8167.1	0.181	0.259	4,395	374.5	0.085	<1.0 OK !
Short period blow up+Holizontal X	0.0	0.000	0.350	2,278	374.5	0.164	<1.0 OK !

STATIC REPORT

PJR－series

5733-H23

8

2016. 01. 26

SankyoTateyama,Inc.

1. Material and Evaluation

①Post

Materi. A6063S−T6(SS)

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N／mm2
DE8389	15.92	662.16	188.59	88.29	39.70	70000	3.44	180

Material evaluation (without support and side panel Vex＝38m/s)

Snow for short period

$\sigma b/fb+\sigma c/fc=$ 0.58 ＜1.0 OK ！

Wind blow down

$\sigma b/fb+\sigma c/fc=$ 0.57 ＜1.0 OK ！

Wind blow up

$\sigma b/fb+\sigma t/ft=$ 0.64 ＜1.0 OK ！

$2 \cdot lk/i=$ 118.5 ＜140 OK ！

②Beam

Materi. A6063S−T6(SS)

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N／mm2
DE8394	10.83	267.79	73.78	43.16	22.02	70000	2.61	180

Material evaluation (without support and side panel Vex＝38m/s)

Snow for short period

$\sigma b/fb=$ 0.64 ＜1.0 OK ！

Wind blow down

$\sigma bx/fbx=$ 0.47 ＜1.0 OK ！

Wind blow up

$\sigma bx/fbx=$ 0.63 ＜1.0 OK ！

③Main frame

Materi. A6063S−T6(SS)

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N／mm2
DE8578有	1.64	5.33	2.07	2.27	0.91	70000	1.13	180

Material evaluation

$\sigma b/fb=$ 0.40 ＜1.0 OK ！

④Front frame

Materi. A6063S−T5

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N／mm2
DE8401	2.55	12.50	6.91	3.81	2.20	70000	1.65	132

Material evaluation

$\sigma b/fb=$ 0.19 ＜1.0 OK ！

⑤Rear frame

Materi. A6063S−T5

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N／mm2
DE8404有	2.55	7.70	5.90	2.34	1.82	70000	1.52	132

Material evaluation

$\sigma b/fb=$ 0.26 ＜1.0 OK ！

⑥Rafter

Materi. A6063S-T5

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N/mm2
DE8654+DE8666	1.88	0.36	3.75	0.53	1.48	70000	1.41	132

Material evaluation

σb/fb= 0.57 <1.0 OK !

⑦Side frame

Materi. A6063S-T5

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N/mm2
DE8683+DE8412	1.65	0.40	2.00	0.32	0.93	70000	1.10	132

Material evaluation

σb/fb= 0.40 <1.0 OK !

⑧Corner bracket

Materi. SPFH590

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N/mm2
GB8064	8.58	205.21	65.07	28.12	20.34	210000	2.75	420

Material evaluation (without support and side panel Vex=38m/s)

σbx/fb= 0.58 <1.0 OK !

σby/fb= 0.10 <1.0 OK !

⑨Main frame connecting parts

Materi. A6063S-T5

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N/mm2
GB8086	2.77	5.59	1.85	2.87	1.69	70000	0.82	132

Material evaluation

τ/fs= 0.01 <1.0 OK !

⑩Front frame connecting parts

Materi. A6063S-T5

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N/mm2
GB8084	2.62	6.94	4.75	2.95	2.26	70000	1.35	132

Material evaluation

τ/fs= 0.01 <1.0 OK !

⑪Rear frame connecting parts

Materi. A6063S-T5

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N/mm2
GB8085	1.92	2.92	1.83	1.78	1.40	70000	0.98	132

Material evaluation

τ/fs= 0.01 <1.0 OK !

⑫Roof material

Materi:　polycarbonate

Material performance

Material	Thickness	Length(short part)	Length(long part)	Inserting	Poisson ratio	Elasticity factor	F value
	cm	cm	cm	cm	ν	kgf/cm2	kgf/cm2
GB4107	0.18	70.3	326.4	1.89	0.3	21000	551

Material evaluation

Bending volume : Wmax＝　1.82 cm

max σx＝　44.50 kgf/cm^2　＜　551.0 kgf/cm^2　∴OK !

Necessary depth of insert ΔL　0.31 cm depth or more　＜　1.89 cm　∴OK !

⑬Roof retainer

Materi: A6063S-T5

Material performance

Material	Cross-section area	Second section moment		Section factor		Elasticity factor	Cross-section radius	F value
	(cm2)	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)	E(N/mm2)	i cm	N／mm2
DE8411	0.79	0.03	1.84	0.08	0.72	70000	1.52	132

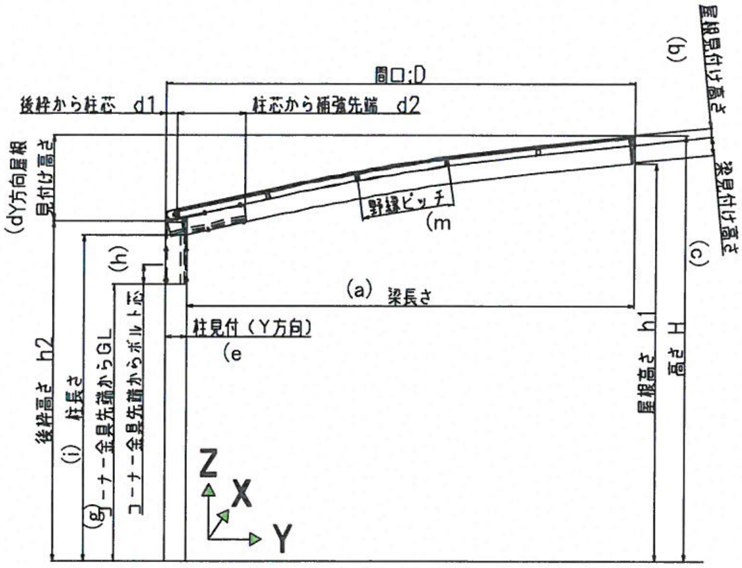
Material evaluation

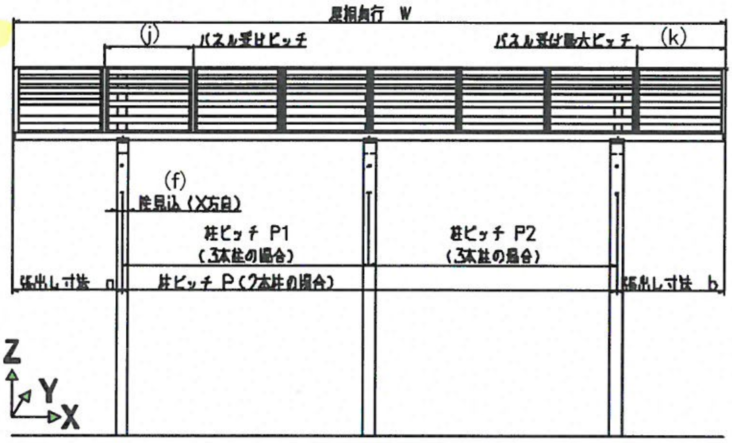
σb/fb=　0.18 ＜1.0　OK !

2. Carport detail

type 5733-H23

Roof projection A=	18.95	m^2
Burden projection per post=	6.32	m^2
Depth:D=	3.300	m
Roof length:W=	5.742	m
from rear frame to post core d1=	0.075	m
from post core to reinforcing end d2=	0.484	m
(a)Beam length=	3.150	m
Overhang length a=	0.871	m
post pitch :P1=	2.000	m
post pitch :P2=	2.000	m
Overhang length b=	0.871	m
(b) Roof part thickness	0.065	m
(c) Beam thickness	0.124	m
(d) Y direction roof part height=	0.588	m
(e) Post dimension(Y direction)=	0.150	m
(f) Post dimension(X direction)=	0.095	m
Overall Height(GL to Roof end) H=	2.936	m
Overall Height(GL to Beam) h1=	2.746	m
Overall Height(GL to Rear frame) h2=	2.348	m
(g) from the end of corner bracket to GL=	1.910	m
(h) from the end of corner bracket to the center of bolts=	0.130	m
(i) Post length=	2.250	m
Post quantity=	3	
(j) Rafter pitch=	0.715	m
(k) Rafter maximum span=	0.726	m
(m) Main frame pitch=	0.645	m





3. Load design

①Vertical over load (G)

Part Weight

Roof	60.0 N/m^2
Post	42.1 N/m

②Snow over load

Post quantity	Snow area	Snow quantity	Unit weight	Short period snow period
2 posts type	General area	20 cm	30 $N/m^2/cm$	600 N/m^2

③ Wind blowing load(Vex=38m/s)

・For design of structure frame

Speed pressureq$=0.6E(Vex\cdot y)^2=$ 708 N/m^2

Standard wind speedVex= 38 m/s

$E=Er^2Gf=$ 1.194

$Er=1.7(Zb/Z_G)^{\alpha}=$ 0.691

Ground surface Div. Ⅲ

Gust influence factor Gf= 2.5

Zb= 5

$Z_G=$ 450

$\alpha=$ 0.2

Installation period factor y= 0.827

・For roof material design

Average speed pressureq' $=0.6Er2(Vex\cdot y)^2=$ 283 N/m^2

④Earthquake power

Earthquake power Qi=Z・Rt・Ai・Co・Wi

Area factorZ= 1.0

Vibration feature Rt= 1.0

Coat shear power distribution factorAi= 1.0

Standard shear power factorC_o = 0.3

4. Preparing calculation

4-1 Carport load (For earthquake power calculation)

Roof	379	N
Post	95	N
Wi=	474	N

Earthquake power Qi=Z·Rt·Ai·Co·Wi= 142.1 N

4-2 Wind pressure power calculation (Maximum wind power pressure for 1 post)

・For design of structure frame

Wind factor		
Independent shed	10	°
C=	0.60	(+pressure)
	-1.00	(-pressure)
	1.2	(Post flat power, side panel)

Wind pressureW=q C=	425 N/m^2	(Wind blow down)
	-708 N/m^2	(Wind blow up)
	849 N/m^2	(Flat)

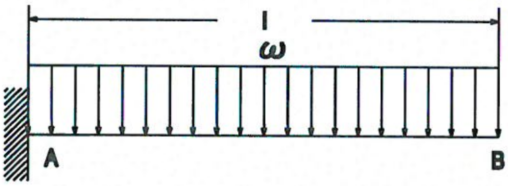
・Roof material design

Peak with factor calculation process Gpe=	3.1	(+pressure)			
	3.0	(-pressure: panel center part)			
	4.0	(-pressure: panel surrounding part)			
Peak wind factor Cf=	3.1	x	0.60	=	1.86
	3.0	x	-1.00	=	-3.00
	4.0	x	-1.00	=	-4.00

Wind pressure W=q' Cf=	527 N/m^2	(Wind blow down)
	-849 N/m^2	(Wind blow up)
	-1132 N/m^2	(Wind blow up)

5. Beam material examination

5-1 Beam load(without support Vex=38m/s)



Load chart

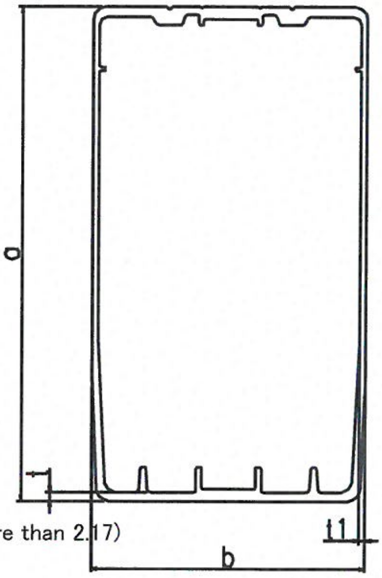
Type			
Vertical load width (m)			2.000
l (m)	D-d1-d2		2.741
Load ω(N/m)	Long period load		120.0
	Short period load		1320.0
	Short period blowing down(vertical)		969.3
	Short period blowing up(vertical)		−1295.5
	Short period blowing down(horizontal)		133.8
	Short period earthquake(vertical)		120.0
	Short period earthquake(horizontal)		36.0
Bending moment M(N・m)	Long period load		450.8
	Short period load		4958.6
	Short period blowing down(vertical)		3641.1
	Short period blowing up(vertical)		−4866.5
	Short period blowing (horizontal)		502.5
	Short period earthquake(vertical)		450.8
	Short period earthquake(horizontal)		135.2
Maximum bending mom (N・m)	maxMx	(long period)	
		(short period)	4958.6
	maxMy	(long period)	
		(short period)	502.5
Second section momer	Ix(cm^4)		267.8
	Iy(cm^4)		73.8
Section factor	Zx(cm^3)		43.2
	Zy(cm^3)		22.0
Elasticity factor	E(N/cm^2)		7000000
Maximum bending stre (N/mm2)	max σx		114.9
	max σy		22.8
Vertical maximum defo	max δx	(cm)	4.97
	max δx/l	1/	116
Flat maximum deforma	max δy	(cm)	1.83
	max δy/l	1/	314

5-2 Beam permissible stress degree
Bending permissible stress degree

Beam

	Permissible stress degree for long period (N／mm2)	Permissible stress for short period(N/m3)
bλ≦bλp	F/ν	Long period x 1.5
bλp<bλ≦bλe	(1.0−0.5((bλ−bλp)/(bλe−bλp)))F/ν	Long period x 1.5
bλe<bλ	$(1/b\lambda^2)\cdot(F/\nu)$	Long period x 1.5

a=	12.40	cm
t=	0.49	cm
t1=	0.20	cm
b=	6.70	cm
Young's modulus factor E=	70000	N/mm^2
Shear elasticity factor of bending materialG=	27000	Nmm
Torsion fixed number of bending material=	164.6	cm^4
Second section moment around weak axis Iy=	73.775	cm^4
Section factor of bending direction Z=	43.163	cm^3
F: Standard strength(N／mm2)＝	180	N/mm^2
bλ=√(My/Me)=	0.14	
$Me=C\sqrt{((\pi^2 EIyGJ)/lb^2)}$=	408296039	Nmm
Bending moment My=	7769340	Nmm
$C=1.75+1.05(M2/M1)+0.3(M2/M1)^2$=	1.75	
M2=	0	Nm
M1=	4866	Nm
M2/M1=	0	
lb=	645.1	mm
bλp=0.6+0.3(M2/M1)=	0.6	
bλe=1／√0. 5=	1.41	



$\nu=3/2+2(b\lambda/b\lambda e)^2/3$ (its value assumes 2.17 in case more than 2.17)

ν= 1.51

bλ≦bλp

Permissible stress degree fb: F／ν＝ 119.5 N/mm^2

Permissible stress degree at bend parts (strong axis)

1) Frange plate of beam <top/bottom face>

Γb : The conversion ratio ＝ b/t・√(F/E)

Γb = 0.65

a) Γb ≦ 1.34 fb ＝ F/1.5

b) 1.34 ＜ Γb ≦ 2.69 fb ＝ F − 0.248FΓb

c) 2.69 ＜ Γb fb ＝ 2.41 F/(Γb^2)

fb= 120.0 N/mm^2

2) Web plate of beam <side face>

Γd : The conversion ratio ＝ d/t・√(F/E)

Γd = 2.90

a) Γd ≦ 3.29 fb ＝ F/1.5

b) 3.29 ＜ Γd ≦ 6.57 fb ＝ F − 0.101FΓ

c) 6.57 ＜ Γd fb ＝ 14.4 F/(Γd^2)

fb= 120.0 N/mm^2

Therefore, result data is…

fbx= 120.0 N/mm^2

fbx= 180.0 N/mm^2

7.76 kN-m

Permissible stress degree at bend parts (weak axis)

1) Frange plate of beam <top/bottom face>

Γb : = b/t・√(F/E)

	Γb =	2.90
a) Γb ≦ 1.34	fb = F/1.5	
b) 1.34 < Γb ≦ 2.69	fb = F − 0.248FΓb	
c) 2.69 < Γb	fb = 2.41 F/(Γb^2)	
	fb=	51.7 N/mm^2

2) Web plate of beam <side face>

Γd : The conversion ratio = d/t・√(F/E)

	Γd =	0.65
a) Γd ≦ 3.29	fb = F/1.5	
b) 3.29 < Γd ≦ 6.57	fb = F − 0.101FΓ	
c) 6.57 < Γd	fb = 14.4 F/(Γd^2)	
	fb=	120.0 N/mm^2

Therefore, result data is…

fby=	51.7 N/mm^2
fby=	**77.6 N/mm^2**

Section of the Beam examination

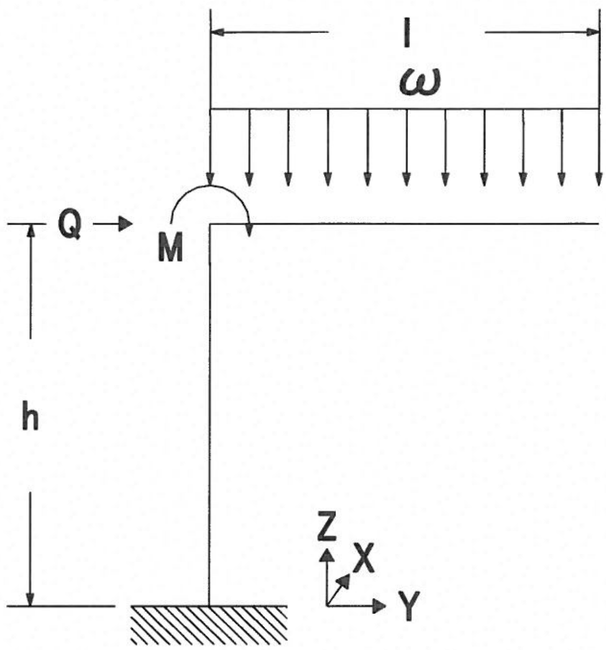
Snow for short period			
M=	4958.6 N・m		
σb=	114.9 N/mm^2		
σb/fb=	0.64	<1.0	OK !
Wind blow down			
M=	3641.1 N・m		
σbx=	84.4 N/mm^2		
σbx/fbx=	0.47	<1.0	OK !
Wind blow up			
M=	-4866.5 N・m		
σbx=	112.7 N/mm^2		
σbx/fbx=	0.63	<1.0	OK !
Wind blow horizontal			
M=	502.5		
σby=	22.8		
σby/fby=	0.29	<1.0	OK !

6. Post material examination

6-1 Post load

Load chart

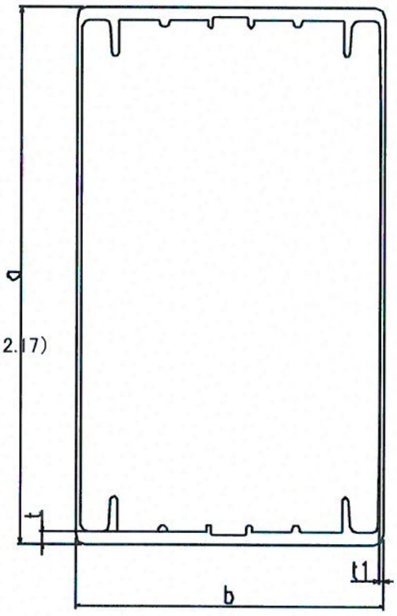
Type		
Vertical load width (m)		2.000
l (m)	D-d1	3.150
Load	Long period load	120.0
ω (N/m)	Short period snow load	1320.0
	Short period blowing down(vertical	969.3
	Short period blowing up(vertical)	-1295.5
	Short period earthquake(vertical)	120.0
Axial force	Long period load	490.8
by vertical load	Short period snow load	4450.8
N(N)	Short period blowing down(vertical	3293.4
	Short period blowing up(vertical)	-4180.3
	Short period earthquake(vertical)	490.8
Flat load	Short period wind X	677.5
Q(N)	Short period wind Y	831.6
	Short period earthquakeX、Y	113.7
Bending moment	Long period load	595.4
M(N·m)	Short period snow load	6548.9
	Short period blowing down(vertical	4808.8
	Short period blowing up(vertical)	-6427.1
	Short period earthquake(vertical)	595.4
Bending moment	Short period blowing down(vertical)+WindY	6679.9
by vertical and flat load	Short period blowing up(vertical)+WindY	-8298.2
Mx(N·m)	Short period earthquake(vertical) + Earthquak	851.2
Bending moment	Short period windX	1524.5
by flat load	Short period earthquakeX	255.8
My(N·m)		
Maximum bending	maxMx (long period)	
moment(N·m)	(short period)	8298.2
	maxMy (short period wind)	1524.5
	(short period earthqua	255.8
Second section moment	$Ix(cm^4)$	662.155
	$Iy(cm^4)$	188.59
Section factor	$Zx(cm^3)$	88.287
	$Zy(cm^3)$	39.70
Max. bending stress deg.	Long period load	6.74
σx(N/mm2)	Short period snow load	74.18
	Short period blowing down(vertical	54.47
	Short period blowing up(vertical)	-72.80
	Short period earthquake(vertical)	6.74
	Short period blowing up(vertical)+WindY	75.66
	Short period blowing down(vertical)+WindY	-93.99
	Short period earthquake(vertical) + Earthquak	9.64
max σx(N/mm2)	Long period	6.74
(uniaxial bending)	Short period(Y direction Vertical load)	93.99
Bending stress degree	Short period windX	38.40
σy(N/mm2)	Short period earthquakeX	6.44



6-2 Post permissible stress degree

Permissible pressure stress degree

	Permissible stress degree for long period (N／mm2)	For short period(N/m3)
$c\lambda \leqq c\lambda p$	F/ν	Long period x 1.5
$c\lambda p < c\lambda \leqq c\lambda e$	$(1.0-0.5((c\lambda-c\lambda p)/(c\lambda e-c\lambda p)))F/\nu$	Long period x 1.5
$c\lambda e < c\lambda$	$(1/c\lambda^2)\cdot(F/\nu)$	Long period x 1.5



a= 15.00 cm
t= 0.56 cm
t1= 0.16 cm
b= 9.50 cm

$c\lambda=(lk/i)\sqrt{(F/\pi^2E)}=$ 1.9

lk : Buckling length(cm) = 407.96 cm
Standard strength F(N／mm2) = 180 N/mm^2
E : Young's modulus factor(N／mm2) = 70000 N/mm^2

$c\lambda p=$ 0.2

$c\lambda e=1/\sqrt{0.5}=$ 1.41

$\nu=3/2+2(c\lambda/c\lambda e)2/3$ (its value assumes 2.17 in case more than 2.17)
$\nu=$ 2.17
H= 203.98 cm
Section second radius i(cm) = 3.44 cm

$c\lambda e < c\lambda$
fc= 34.8 N/mm^2

Permissible stress degree at bend parts

1) Frange plate of beam <top/bottom face>

$\Gamma b := b/t\cdot\sqrt{(F/E)}$

$\Gamma b =$ 0.83

a) $\Gamma b \leqq 1.34$ fb = F/1.5
b) $1.34 < \Gamma b \leqq 2.69$ fb = F − 0.248F Γb
c) $2.69 < \Gamma b$ fb = 2.41 $F/(\Gamma b^2)$

fc= 120.0 N/mm^2

2) Web plate of beam <side face>

$\Gamma d := d/t\cdot\sqrt{(F/E)}$

$\Gamma d =$ 4.40

a) $\Gamma d \leqq 1.34$ fb = F/1.5
b) $1.34 < \Gamma d \leqq 2.69$ fb = F − 0.248F Γd
c) $2.69 < \Gamma d$ fb = 2.41 $F/(\Gamma d^2)$

fc= 22.4 N/mm^2

Therefore, result date is・・・

fc= 22.4 N/mm^2

fc= 33.6 N/mm^2

Column.

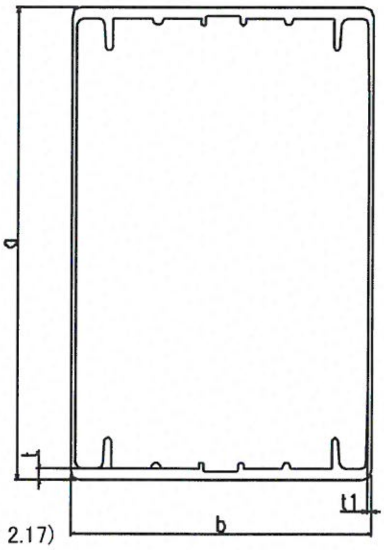
6-3 Permissible stress degree at bend parts

Permissible bending stress degree

	Permissible stress degree for long period (N/mm2)	For short period(N/m3)
bλ≦bλp	F/ν	Long period x 1.5
bλp<bλ≦bλe	(1.0−0.5((bλ−bλp)/(bλe−bλp)))F/ν	Long period x 1.5
bλe<bλ	$(1/b\lambda^2)\cdot(F/\nu)$	Long period x 1.5

a=	15.00	cm
t=	0.56	cm
t1=	0.16	cm
b=	9.50	cm

Young's modulus factor E=	70000	N/mm^2
Shear elasticity factor of bending material G=	27000	Nmm
Torsion fixed number of bending material=	340.2	cm^4
Second section moment around weak axis Iy=	188.588	cm^4
Section factor of bending direction Z=	88.287	cm^3
F: Standard strength (N/mm2)=	180	N/mm^2
bλ=√(My/Me)=	0.30	
$Me=C\sqrt{((\pi^2 EIyGJ)/lb^2)}$=	181147397	Nmm
Bending moment My=	15891660	Nmm
$C=1.75+1.05(M2/M1)+0.3(M2/M1)^2$=	1	
M2=	−6427.1	Nm
M1=	6427.1	Nm
M2/M1=	−1	
lb=	1909.8	mm
bλp=0.6+0.3(M2/M1)=	0.3	
bλe=1/√0.5=	1.41	



$\nu=3/2+2(b\lambda/b\lambda e)^2/3$ (its value assumes 2.17 in case more than 2.17)

ν= 1.53

bλ≦bλp

Permissble stress degree fb: F/ν= 117.7 N/mm^2

Permissible bending stress degree (strong axis)

1) Frange plate <top/bottom face>

Γb : The conversion ratio = b/t・√(F/E)

Γb = 0.83

a) Γb ≦ 1.34 fc = F/1.5

b) 1.34 < Γb ≦ 2.69 fc = F − 0.248FΓb

c) 2.69 < Γb fc = 2.41 F/(Γb2)

fb= 120.0 N/mm^2

2)Web plate <side face>

Γd : The conversion ratio = d/t・√(F/E)

Γd = 4.40

a) Γd ≦ 3.29 fb = F/1.5

b) 3.29 < Γd ≦ 6.57 fb = F − 0.101FΓd

c) 6.57 < Γd fb = $14.4\,F/(\Gamma d^2)$

fb= 100.0 N/mm^2

Therefore, result date is・・・

fbx= 100.0 N/mm^2

fbx= 150.0 N/mm^2

Permissible bending stress degree (weak axis)

1) Frange plate <top/bottom face>

Γb : The conversion ratio = b/t・√(F/E)

Γb= 4.40

a) Γb ≦ 1.34 fc = F/1.5

b) 1.34 < Γb ≦ 2.6 9 fc = F − 0.248FΓd

c) 2.69 < Γb fc = 2.41 F/(Γd2)

fb= 22.4 N/mm^2

---

2) Web plate <side face>

Γd : The conversion ratio = d/t・√(F/E)

Γd= 0.83

a) Γd ≦ 3.29 fb = F/1.5

b) 3.29 < Γd ≦ 6.57 fb = F − 0.101FΓd

c) 6.57 < Γd fb = 14.4 F/($Γd^2$)

fb= 120.0 N/mm^2

Therefore, result date is・・・

fby= 22.4 N/mm^2

---

fby= 33.6 N/mm^2

Examination of the section of the post

Short period snow load

σb= 74.2 N/mm^2

σc=N/A= 2.8 N/mm^2

σb/fb+σc/fc= 0.58 <1.0 OK !

Wind blow down

σb= 75.7 N/mm^2

σc=N/A= 2.1 N/mm^2

σb/fb+σc/fc= 0.57 <1.0 OK !

Wind blow up

σb= 94.0 N/mm^2

σt=N/A= 2.6 N/mm^2

σb/fb+σt/ft= 0.64 <1.0 OK !

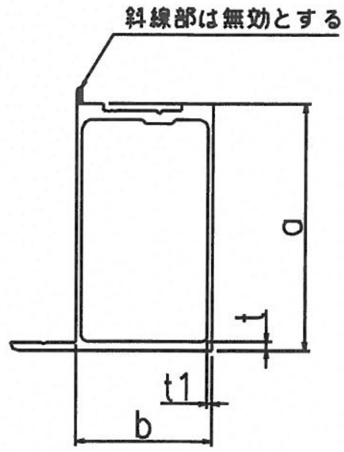
2・lk/i= 118.5 <140 OK !

7. Main Frame Bending permissible stress degree

7-1 Bending permissible stress degree

	Permissible stress degree for long period (N／mm2)	Permissible stress for short period(N/m3)
bλ≦bλp	F/ν	Long period x 1.5
bλp<bλ≦bλe	(1.0−0.5((bλ−bλp)/(bλe−bλp)))F/ν	Long period x 1.5
bλe<bλ	$(1/b\lambda^2)\cdot(F/\nu)$	Long period x 1.5

a=	4.60	cm
t=	0.10	cm
t1=	0.09	cm
b=	2.50	cm
Young's modulus factor E=	70000	N/mm^2
Shear elasticity factor of bending materialG＝	27000	Nmm
Torsion fixed number of bending material＝	3.2	cm^4
Second section moment around weak axis Iy=	2.072	cm^4
Section factor of bending direction Z=	2.274	cm^3
F：Standard strength(N／mm2)＝	180	N/mm^2
bλ=√(My/Me)=	0.27	
Me=C√((π2EIyGJ)/lb2)=	5535840	Nmm
Bending moment My=	409320	Nmm
C=	1.13	
lb=	715	mm
bλp=0.6+0.3(M2/M1)=	0.3	
bλe=1/√0.5=	1.41	



$\nu=3/2+2(b\lambda/b\lambda e)^2/3$ (its value assumes 2.17 in case more than 2.17)

ν＝ 1.52

bλ≦bλp

fb= 118.1 N/mm^2

Permissible stress degree at bend parts

1) Frange plate of beam <top/bottom face>

Γb : The conversion ratio ＝ b/t・√(F/E)

Γb＝ 0.41

a) Γb ≦ 0.438 fb ＝ F/1.5

b) 0.438 ＜ Γb ≦ 0.876 fb ＝ F － 0.760FΓb

c) 0.876 ＜ Γb fb ＝ $0.256\ F/(\Gamma b^2)$

fb= 120.0 N/mm^2

Γb : The conversion ratio ＝ b/t・√(F/E)

Γb＝ 1.18

a) Γb ≦ 1.34 fc ＝ F/1.5

b) 1.34 ＜ Γb ≦ 2.69 fc ＝ F － 0.248FΓd

c) 2.69 ＜ Γb fc ＝ 2.41 F/(Γd2)

fb= 120.0 N/mm^2

2) Wave plate of beam <side face>

Γb : The conversion ratio ＝ b/t・√(F/E)

Γd＝ 2.48

a) Γd ≦ 3.29 fb ＝ F/1.5

b) 3.29 ＜ Γd ≦ 6.57 fb ＝ F － 0.101FΓ

c) 6.57 ＜ Γd fb ＝ $14.4\ F/(\Gamma d^2)$

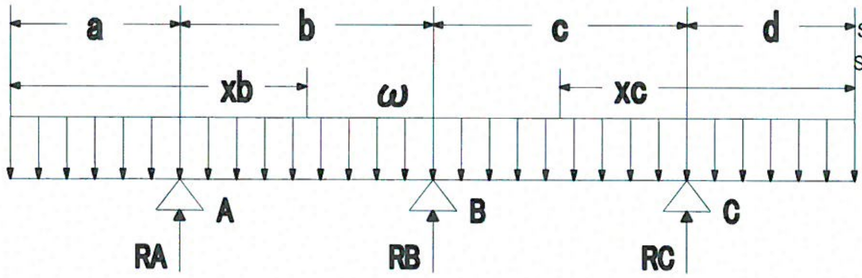
fb= 120.0 N/mm^2

Therefore, result data is…

fb= 118.1 N/mm^2

fb= 177.1 N/mm^2

7-2 Calculation of Main Frame Section



Parts Width=	0.645 m
Long period snow ω=	38.7 N/m
Short period snow load ω=	425.8 N/m
Short period blow down ω=	312.6 N/m
Short period blow up ω=	417.9 N/m
ω=	425.8 N/m
a=	0.871 m
b=	2 m
c=	2 m
d=	0.871 m
xb=	1.4355 m
xc=	1.4355 m
Z=	2.274 cm^3
I=	5.325 cm^4
E=	7000000 N/cm^2

W=Full-Load M=Bend Moment
R=Anti-Power θ=Rotation Angle
Q=Shear Power δ=Bend

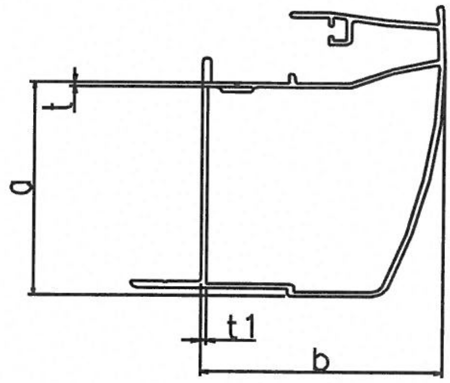
W= w(a+b+c+d)	=	2444.7 N
RA= $w(6a^2b+4a^2c+8ab^2+8abc+3b^3+4b^2c-c^3+2cd^2)/8b(b+c)$	=	811.3 N
RB= $w(4b^2c+4bc^2-4bd^2-2a^2b-2cd^2+c^3-4a^2c+b^3)/8bc$	=	822.2 N
RC= $w(6cd^2+4bd^2++8c^2d+8bcd+3c^3+4bc^2-b^3+2a^2b)/8c(b+c)$	=	811.3 N
MA= $-(wa^2/2)$	=	-161.5 N·m
σA= MA/Z	=	71.0 N/mm^2
MB= $w\{b(2a^2-b^2)+c(2d^2-c^2)\}/8(b+c)$	=	-132.1 N·m
σB= MB/Z	=	58.1 N/mm^2
MC= $-(wd^2/2)$	=	-161.5 N·m
σC= MC/Z	=	71.0 N/mm^2
MXb= $-wx^2/2+RA(x-a)$	=	19.3 (b material)
σXb= MX/Z	=	8.5 N/mm^2
MXc= $-wx^2/2+RC(x-d)$	=	19.3 (c material)
σXc= MX/Z	=	8.5 N/mm^2
σb/fb	=	0.40 <1.0 OK !

8. Front frame bending permissible stress degree

8-1 Bending permissible stress degree

	Permissible stress degree for long period (N／mm2)	Permissible stress for short period(N/m3)
bλ≦bλp	F/ν	Long period x 1.5
bλp<bλ≦bλe	(1.0−0.5((bλ−bλp)/(bλe−bλp)))F/ν	Long period x 1.5
bλe<bλ	(1/bλ²)・(F/ν)	Long period x 1.5

a=	4.77	cm
t=	0.10	cm
t1=	0.10	cm
b=	4.20	cm
Young's modulus factor E=	70000	N/mm^2
Shear elasticity factor of bending materialG＝	27000	Nmm
Torsion fixed number of bending material＝	8.4	cm^4
Second section moment around weak axis Iy=	6.911	cm^4
Section factor of bending direction Z=	3.805	cm^3
F:Standard strength(N／mm2)＝	132	N/mm^2
bλ=√(My/Me)=	0.17	
Me=C√((π2EIyGJ)/lb2)=	16407392	Nmm
Bending moment My=	502260	Nmm
C=	1.13	
lb=	715	mm
bλp=0.6+0.3(M2/M1)=	0.3	
bλe=1/√0.5=	1.41	



$\nu=3/2+2(b\lambda/b\lambda e)^2/3$ (its value assumes 2.17 in case more than 2.17)

ν= 1.51

bλ≦bλp

fb= 87.4 N/mm^2

Permissible stress degree at bend parts

1) Frange plate of beam <top/bottom face>

Γb : The conversion ratio ＝ b/t・√(F/E)

Γb = 1.74

a) Γb ≦ 1.34 fc ＝ F/1.5

b) 1.34 < Γb ≦ 2.69 fc ＝ F − 0.248FΓd

c) 2.69 < Γb fc ＝ 2.41 F/(Γd2)

fb= 75.1 N/mm^2

2) Web plate of beam <side face>

Γd ＝d/t・√(F/E)

Γd = 1.98

a) Γd ≦ 3.29 fb ＝ F/1.5

b) 3.29 < Γd ≦ 6.57 fb ＝ F − 0.101FΓ

c) 6.57 < Γd fb ＝ 14.4 F/($Γd^2$)

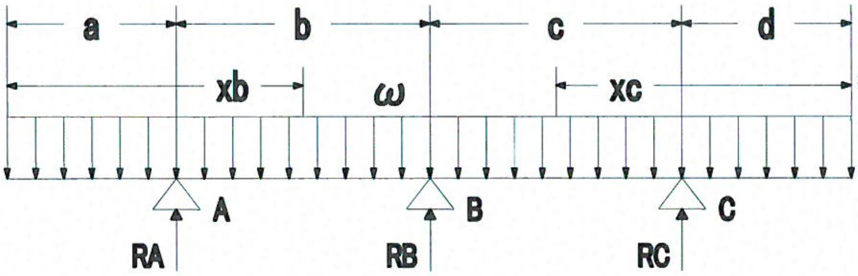
fb= 88.0 N/mm^2

Therefore, result data is…

fb= 75.1 N/mm^2

fb= 112.7 N/mm^2

8-2 Calculation of Front Frame Section



Parts Width=	0.323 m
Long period snow ω=	19.4 N/m
Short period snow load ω=	212.9 N/m
Short period blow down ω=	156.3 N/m
Short period blow up ω=	208.9 N/m
ω=	212.9 N/m
a=	0.871 m
b=	2 m
c=	2 m
d=	0.871 m
xb=	1.4355 m
xc=	1.4355 m
Z=	3.805 cm^3
I=	12.495 cm^4
E=	7000000 N/cm^2

W=Full-Load M=Bend Moment

R=Anti-Power θ=Rotation Angle

Q=Shear Power δ=Bend

W= w(a+b+c+d)	=	1222.4 N
RA= $w(6a^2b+4a^2c+8ab^2+8abc+3b^3+4b^2c-c^3+2cd^2)/8b(b+c)$	=	405.6 N
RB= $w(4b^2c+4bc^2-4bd^2-2a^2b-2cd^2+c^3-4a^2c+b^3)/8bc$	=	411.1 N
RC= $w(6cd^2+4bd^2++8c^2d+8bcd+3c^3+4bc^2-b^3+2a^2b)/8c(b+c)$	=	405.6 N
MA= $-(wa^2/2)$	=	-80.8 N・m
σA= MA/Z	=	21.2 N/mm^2
MB= $w\{b(2a^2-b^2)+c(2d^2-c^2)\}/8(b+c)$	=	-66.1 N・m
σB= MB/Z	=	17.4 N/mm^2
MC= $-(wd^2/2)$	=	-80.8 N・m
σC= MC/Z	=	21.2 N/mm^2
MXb= $-wx^2/2+RA(x-a)$	=	9.6 (b material)
σXb= MX/Z	=	2.5 N/mm^2
MXc= $-wx^2/2+RC(x-d)$	=	9.6 (c material)
σXc= MX/Z	=	2.5 N/mm^2
σb/fb	=	0.19 <1.0 OK !

9. Bending permissible stress degree at rear frame

9-1 Calculation method of effective section

$\Gamma b = b/t \cdot \sqrt{(F/E)} = 0.438$ Therefore…

$b/t = 0.438/\sqrt{(F/E)} = 10.09$

Effective Depth

t2= 1.70 mm

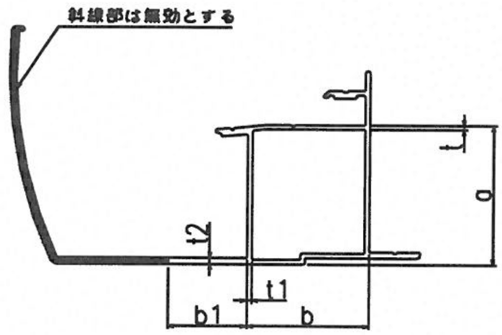
b1= 17.15 mm

9-2. Bending permissible stress degree at rear frame

Bending permissible stress degree

	Permissible stress degree for long period (N／mm2)	Permissible stress for short period(N/m3)
$b\lambda \leqq b\lambda p$	F/ν	Long period x 1.5
$b\lambda p < b\lambda \leqq b\lambda e$	$(1.0-0.5((b\lambda - b\lambda p)/(b\lambda e - b\lambda p)))F/\nu$	Long period x 1.5
$b\lambda e < b\lambda$	$(1/b\lambda^2)\cdot(F/\nu)$	Long period x 1.5

a=	3.82	cm
t=	0.12	cm
t1=	0.12	cm
b=	2.95	cm
Young's modulus factor E=	70000	N/mm^2
Shear elasticity factor of bending materialG＝	27000	Nmm
Torsion fixed number of bending material＝	4.0	cm^4
Second section moment around weak axis Iy=	7.702	cm^4
Section factor of bending direction Z=	2.344	cm^3
F:Standard strength(N／mm2)＝	132	N/mm^2
$b\lambda = \sqrt{(My/Me)}$=	0.16	
$Me = C\sqrt{((\pi^2 EIyGJ)/lb^2)}$=	12025195	Nmm
Bending moment My=	309408	Nmm
C=	1.13	
lb=	715	mm
$b\lambda p = 0.6+0.3(M2/M1)$=	0.3	
$b\lambda e = 1/\sqrt{0.5}$=	1.41	



$\nu = 3/2 + 2(b\lambda / b\lambda e)^2/3$ (its value assumes 2.17 in case more than 2.17)

ν = 1.51

$b\lambda \leqq b\lambda p$

fb= 87.5 N/mm^2

Permissible stress degree at bend parts

1) Frange plate of beam <top/bottom face>

Γb : The conversion ratio $= b/t \cdot \sqrt{(F/E)}$

Γb = 0.98

a) $\Gamma b \leqq 1.34$ — $fc = F/1.5$

b) $1.34 < \Gamma b \leqq 2.69$ — $fc = F - 0.248F\Gamma d$

c) $2.69 < \Gamma b$ — $fc = 2.41\ F/(\Gamma d2)$

fb= 88.0 N/mm^2

2) Web plate of beam <side face>

$\Gamma d = d/t \cdot \sqrt{(F/E)}$

Γd = 1.30

a) $\Gamma d \leqq 3.29$ — $fb = F/1.5$

b) $3.29 < \Gamma d \leqq 6.57$ — $fb = F - 0.101F\Gamma$

c) $6.57 < \Gamma d$ — $fb = 14.4\ F/(\Gamma d^2)$

fb= 88.0 N/mm^2

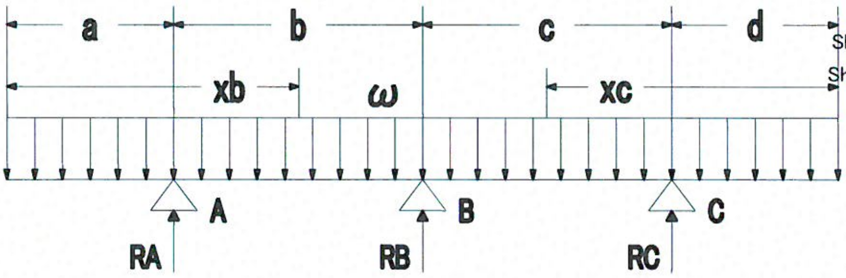
Therefore, result data is…

fb= 87.5 N/mm^2

fb= 131.2 N/mm^2

9-3 Calculation of Rear Frame Section

Parts Width=	0.323 m



Long period snow ω=	19.4 N/m
Short period snow load ω=	212.9 N/m
Short period blow down ω=	156.3 N/m
Short period blow up ω=	208.9 N/m
ω=	212.9 N/m
a=	0.871 m
b=	2 m
c=	2 m
d=	0.871 m
xb=	1.4355 m
xc=	1.4355 m
Z=	2.344 cm^3
I=	7.702 cm^4
E=	7000000 N/cm^2

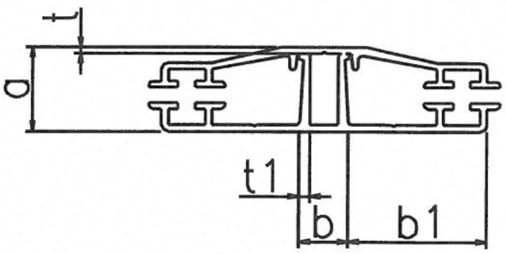
W=Full-Load M=Bend Moment
R=Anti-Power θ =Rotation Angle
Q=Shear Power δ =Bend

W= w(a+b+c+d)	=	1222.4 N
RA= $w(6a^2b+4a^2c+8ab^2+8abc+3b^3+4b^2c-c^3+2cd^2)/8b(b+c)$	=	405.6 N
RB= $w(4b^2c+4bc^2-4bd^2-2a^2b-2cd^2+c^3-4a^2c+b^3)/8bc$	=	411.1 N
RC= $w(6cd^2+4bd^2++8c^2d+8bcd+3c^3+4bc^2-b^3+2a^2b)/8c(b+c)$	=	405.6 N
MA= $-(wa^2/2)$	=	-80.8 N・m
σA= MA/Z	=	34.5 N/mm^2
MB= $w[b(2a^2-b^2)+c(2d^2-c^2)]/8(b+c)$	=	-66.1 N・m
σB= MB/Z	=	28.2 N/mm^2
MC= $-(wd^2/2)$	=	-80.8 N・m
σC= MC/Z	=	34.5 N/mm^2
MXb= $-wx^2/2+RA(x-a)$	=	9.6 (b material)
σXb= MX/Z	=	4.1 N/mm^2
MXc= $-wx^2/2+RC(x-d)$	=	9.6 (c material)
σXc= MX/Z	=	4.1 N/mm^2
$\sigma b/fb$	=	0.26 ＜1.0 OK !

10. Rafter / Roof retainer bending permissible stress degree

10-1 Bending permissible stress degree

a=	1.30	cm
t=	0.10	cm
t1=	0.17	cm
b=	0.72	cm
b1=	1.99	cm
Young's modulus factor E=	70000	N/mm^2
Shear elasticity factor of bending materialG=	27000	Nmm
Second section moment around weak axis Iy=	0.364	cm^4
Section factor of bending direction Z=	0.529	cm^3
F: Standard strength (N/mm2) =	132	N/mm^2



Therefore…

fb= 88.0 N/mm^2

Permissible stress degree at bend parts

Frange plate of beam <top/bottom face>

Γb : The conversion ratio = b/t・√(F/E)

Γb = 0.86

a) Γb ≦ 0.438 fb = F/1.5

b) 0.438 < Γb ≦ 0.876 fb = F − 0.760FΓb

c) 0.876 < Γb fb = 0.256 F/(Γb2)

fb= 45.3 N/mm^2

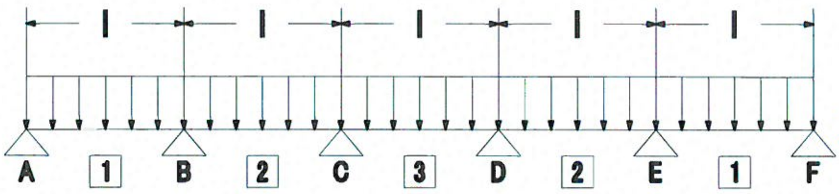
Therefore…

fb= 45.3 N/mm^2

fb= 68.0 N/mm^2

10-2 Calculation of Rafter / Roof retainer section

Parts Width=	0.715 m
l=	0.645 m



Long period ω=	42.9 N/m
Short period snow load ω=	471.9 N/m
Short period blow down ω=	346.5 N/m
Short period blow up ω=	−463.1 N/m
ω=	471.9 N/m
Z=	0.529 cm^3
I=	0.364 cm^4
E=	7000000 N/cm^2

W=Full-Load   M=Bend Moment
R=Anti-Power θ =Rotation Angle
Q=Shear Power δ =Bend

	ωl	=	304.4 N
RA=	0.395 ＊ ωl	=	120.2 N
RB=	1.131 ＊ ωl	=	344.3 N
RC=	0.974 ＊ ωl	=	296.5 N
RD=	0.974 ＊ ωl	=	296.5 N
RE=	1.131 ＊ ωl	=	344.3 N
RF=	0.395 ＊ ωl	=	120.2 N
Rmax=			344.3 N
MB=	−0.105+ ＊ ωl^2	=	−20.6 N・m
MC=	−0.079 ＊ ωl^2	=	−15.5 N・m
MD=	−0.079 ＊ ωl^2	=	−15.5 N・m
ME=	−0.105+ ＊ ωl^2	=	−20.6 N・m
M1=	0.078 ＊ ωl^2	=	15.3 N・m
M2=	0.033 ＊ ωl^2	=	6.5 N・m
M3=	0.046 ＊ ωl^2	=	9.0 N・m
σX=	MX/Z	=	39.0 N/mm^2
	σb/fb	=	0.57 <1.0 OK !

11. Side frame bending permissible stress degree

11-1 Calculation method of effective section

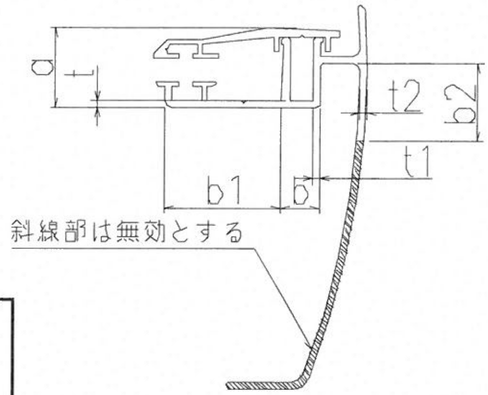
Γb = b/t· √(F/E) = 0.438 Therefore…

b/t = 0.438/√(F/E) = 10.09

Effective Depth

t2= 1.20 mm

b2= 12.10 mm



11-2 Bending permissible stress degree

a=	1.30	cm
t=	0.11	cm
t1=	0.17	cm
b=	0.72	cm
b1=	1.99	cm
Young's modulus factor E=	70000	N/mm^2
Shear elasticity factor of bending materialG=	27000	Nmm
Second section moment around weak axis Iy=	2	cm^4
Section factor of bending direction Z=	0.324	cm^3
F: Standard strength(N／mm2)＝	132	N/mm^2

Therefore…

fb= 88.0 N/mm^2

Permissible stress degree at bend parts

Frange plate of beam <top/bottom face>

Γb : The conversion ratio ＝ b/t · √(F/E)

Γb = 0.79

a) Γb ≦ 0.438　　fb ＝ F/1.5

b) 0.438 ＜ Γb ≦ 0.876　　fb ＝ F − 0.760FΓb

c) 0.876 ＜ Γb　　fb ＝ 0.256 F/(Γb2)

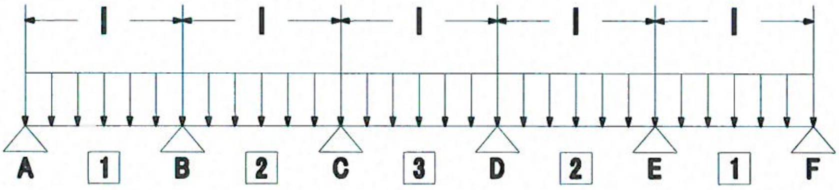
fb= 53.2 N/mm^2

Therefore…

fb= 53.2 N/mm^2

fb= 79.8 N/mm^2

11-3 Calculation of Side frame secton



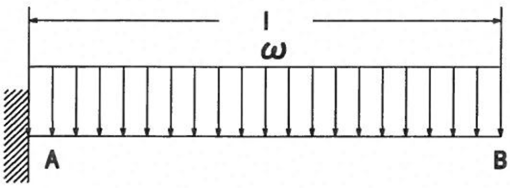
Parts Width=	0.363 m
l=	0.645 m
Long period ω=	21.8 N/m
Short period snow load ω=	239.6 N/m
Short period blow down ω=	175.9 N/m
Short period blow up ω=	-235.1 N/m
ω=	239.6 N/m
Z=	0.324 cm^3
I=	0.399 cm^4
E=	7000000 N/cm^2

W=Full-Load　M=Bend Moment
R=Anti-Power　θ=Rotation Angle
Q=Shear Power　δ=Bend

	ωl	=	154.6 N
RA=	0.395 * ωl	=	61.0 N
RB=	1.131 * ωl	=	174.8 N
RC=	0.974 * ωl	=	150.5 N
RD=	0.974 * ωl	=	150.5 N
RE=	1.131 * ωl	=	174.8 N
RF=	0.395 * ωl	=	61.0 N
Rmax=			174.8 N
MB=	$-0.105+ * \omega l^2$	=	-10.5 N·m
MC=	$-0.079 * \omega l^2$	=	-7.9 N·m
MD=	$-0.079 * \omega l^2$	=	-7.9 N·m
ME=	$-0.105+ * \omega l^2$	=	-10.5 N·m
M1=	$0.078 * \omega l^2$	=	7.8 N·m
M2=	$0.033 * \omega l^2$	=	3.3 N·m
M3=	$0.046 * \omega l^2$	=	4.6 N·m
σX=	MX/Z	=	32.3 N/mm^2
	σb/fb	=	0.40 <1.0 OK !

12. Corner bracket examination

12-1 Beam load



Load chart

Type			
Vertical load width (m)			2.000
l (m)	D-d1		3.225
Load ω(N/m)	Long period load		120.0
	Short period snow load		1320.0
	Short period blowing up(vertical)		969.3
	Short period blowing up(vertical)		-1175.5
	Short period blowing down(horizontal)		160.5
	Short period earthquake(vertical)		120.0
	Short period earthquake(horizontal)		36.0
Bending moment M(N･m)	Long period load		624.0
	Short period snow load		6864.4
	Short period blowing up(vertical)		5040.6
	Short period blowing up(vertical)		-6112.8
	Short period blowing down(horizontal)		834.7
	Short period earthquake(vertical)		624.0
	Short period earthquake(horizontal)		187.2
Maximum bending momen (N･m)	maxMx	(long period)	
		(short period)	6864.4
	maxMy	(long period)	
		(short period)	834.7
Second section moment	Ix(cm^4)		267.8
	Iy(cm^4)		73.8
Section factor	Zx(cm^3)		43.2
	Zy(cm^3)		22.0
Elasticity factor	E(N/cm^2)		21000000
Maximum bending stress degree (N/mm2)	max σ x		159.0
	max σ y		37.9
Vertical maximum deformation quantity	max δ x (cm)		3.17
	max δ x/l	1/	181
Flat maximum deformation quantity	max δ y (cm)		1.40
	max δ y/l	1/	410

12-2 Calculation of Corner bracket Section

Material	Second section moment		Section factor	
	Ix(cm4)	Iy(cm4)	Zx(cm3)	Zy(cm3)
GB8064	205.211	65.073	28.119	20.335

fb= 420 N/mm^2
Mx= 6864.4 N･m
My= 834.7 N･m

σbx= 244.1 N/mm^2
σby= 41.0 N/mm^2

σbx/fb= 0.58 <1.0 OK !
σby/fb= 0.10 <1.0 OK !

13. Examination of main frame connecting part

13-1 Calculation of Load

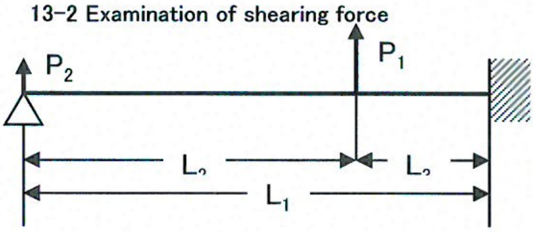
・Anti-Power of rafter

P_1= P1= 344.3 N ←from "Calculation of rafter"

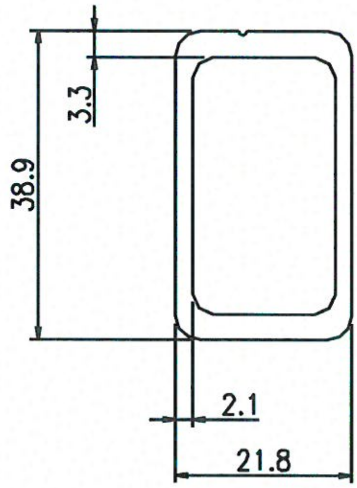
・Anti-Power of connecting rafter

P_2= P2= 172.2 N ←(Anti-Power of rafter)/2

13-2 Examination of shearing force



L_1(m)	0.87
L_2(m)	0.715
L_3(m)	0.16
A(mm^2)	276.8
fs(N/mm^2)	76.2



$Q= (P_1 \cdot L_3^2) \cdot (3L_2+2L_3)/(2L_1^3)+P_2$ より

Q= 187.7 N

τ=Q/A= 0.68 N/mm^2

τ/fs= 0.01 ＜1.0 OK !

14. Examination of front frame connecting part

14-1 Calculation of Load

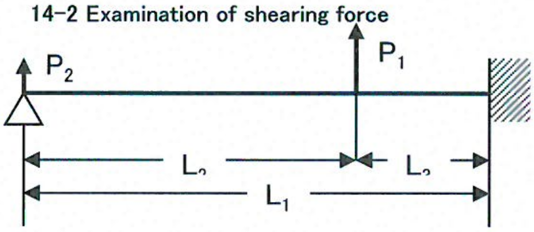
・Anti-Power of rafter

P_1= P1= 120.2 N ←from "Calculation of rafter"

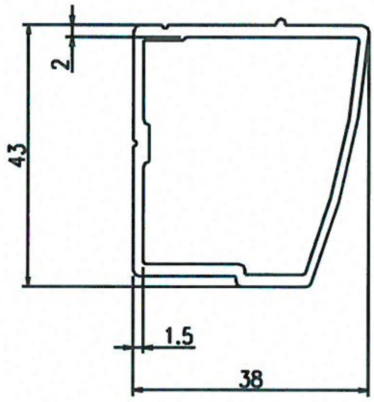
・Anti-Power of connecting rafter

P2= 60.1 N ←(Anti-Power of rafter)/2

14-2 Examination of shearing force



L_1(m)	0.87
L_2(m)	0.715
L_3(m)	0.16
A(mm^2)	261.6
fs(N/mm^2)	76.2



$Q= (P_1 \cdot L_3^2) \cdot (3L_2+2L_3)/(2L_1^3)+P_2$ より

Q= 65.6 N

τ=Q/A= 0.25 N/mm^2

τ/fs= 0.01 ＜1.0 OK !

15. Examination of gutter connecting part

15-1 Calculation of Load

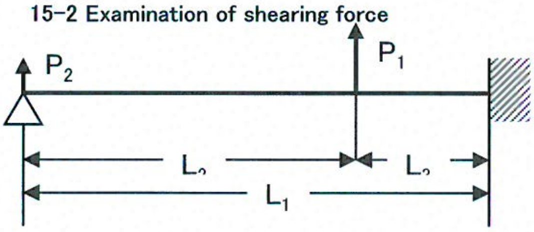
・Anti-Power of rafter

P1= 120.2 N ←from "Calculation of rafter"

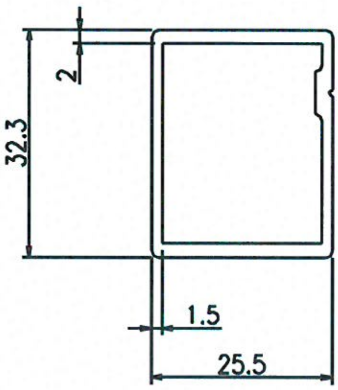
・Anti-Power of connecting rafter

P2= 60.1 N ←(Anti-Power of rafter)/2

15-2 Examination of shearing force



L_1(m)	0.87
L_2(m)	0.715
L_3(m)	0.16
A(mm^2)	192.1
fs(N/mm^2)	76.2



$Q= (P_1 \cdot L_3^2) \cdot (3L_2+2L_3)/(2L_1^3)+P_2$ より

Q= 65.6 N

τ=Q/A= 0.34 N/mm^2

τ/fs= 0.01 ＜1.0 OK !

16. Examination of main frame and beam connection

16-1 Examination of screw pull-out force

・Pull-out force/screw

T= 411.1 N

・Stretching permissible stress

$ft= 2.1 \cdot \beta \cdot ((d^2-d_1^2)/(P \cdot d^4))^{0.5} \cdot t^{1.2} \cdot Ft \cdot 1.5$

= 172.7 N/mm^2

・Effective section

A= 11.2 mm^2

σt= 36.6 N/mm^2

$\sigma t/ft$= 0.21 <1.0 OK !

β	0.6
Screw diameter	5
Core diameter	3.78
Pitch	0.8
t(Thickness)	4.6
Ft(Standard strength)	100

16-2 Examination of Beam bending stress

・Beam top face bending moment

M= 2306.4 N・mm

Z= 58.6 mm^3

σb= 39.4 N/mm^2

$\sigma b/fb$= 0.19 <1.0 OK !

b(Beam depth dimension)	61
t(Thickness)	2.4
a(load point)	18.5

17. Examination of rafter and main frame connection

17-1 Examination of screw pull-out force

・Pull-out force/screw

T= 344.3 N

・Stretching permissible stress

$ft= 2.1 \cdot \beta \cdot ((d^2-d_1^2)/(P \cdot d^4))^{0.5} \cdot t^{1.2} \cdot Ft \cdot 1.5$

= 104.5 N/mm^2

・Effective section

A= 6.7 mm^2

σt= 51.1 N/mm^2

$\sigma t/ft$= 0.49 <1.0 OK !

β	0.6
Screw diameter	4
Core diameter	2.93
Pitch	0.7
t(Thickness)	2.3
Ft(Standard strength)	100

17-2 Examination of Main frame bending stress

・Main frame top face bending moment

M= 991.6 N・mm

Z= 22.0 mm^3

σb= 45.0 N/mm^2

$\sigma b/fb$= 0.22 <1.0 OK !

b(Beam depth dimension)	25
t(Thickness) center	2.3
a(load point)	10

18. Examination of Roof material

18-1 Examination of Bending volume

Poisson ratio : ν =	0.3	
Distribution Load : P=	0.0116	kgf/cm^2
E: Young's modulus factor =	21000	kgf/cm^2
Thickness : h=	0.18	cm
Short edge a=	70.3	cm
Long edge b=	326.4	cm

Bending volume : Wmax

$A \cdot Wmax^3 + B \cdot Wmax + C = 0$

$A = (4\nu/a^2b^2 + (3-\nu^2)\cdot(1/a^4+1/b^4))/h^3$

= 2086.4

$B = (4/3)\cdot(1/a^2+1/b^2)^2/h$

= 33.2

$C = -256(1-\nu^2)P/(\pi^6 E h^4)$

= -12701.0

Bending volume : Wmax= 1.82 cm

18-2 Bending stress degree

$max\,\sigma x = ((\pi^2 \cdot E \cdot Wmax)/(8\cdot(1-\nu^2)))\cdot((2-\nu^2)Wmax+4h)/a^{2+}(\nu(Wmax+4h))/b2)$

= 44.5 kgf/cm^2 < 551 kgf/cm^2 ∴OK !

18-3 Necessary depth of insert

Necessary depth of insert ΔL

ΔL = ΔX x SF + ΔI

However, ΔX : The gap volume by a bend

= (lx − b)／2

lx : Arc length while bending

= 2 x sin−1〔(b／2)／r〕x r

r : Radius rate while bending

= (b2+4δ2)／8δ

δ : Bending rate of Polycarbonate = Wmax (cm)

b : Length of short (cm)

ΔI : The volume of expansion and contraction at temperature

= K・Δt・b／2

K : Line coefficient of expansion (cm／cm／℃)

Δt : Temperature differency at 50℃

SF : Safety ratio SF=3.0

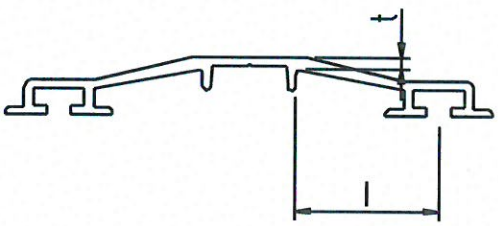
r=	339.8	
lx=	70.43	cm
ΔX=	0.06	cm
K=	0.00007	cm/cm/℃
Δt =	50	℃
SF=	3.0	
ΔI=	0.12	cm

Therefore…

ΔL= 0.31 cm depth or more < 1.89 cm ∴OK !

19. Examination of Roof retainer

Rafter pitch=	715	mm
Supporting length l=	15	mm
Material thickness t=	1.2	mm
F: Standard strength=	132	N/mm^2
Blow up load ω=	383.4	N/m
Load P=ωb=	3.834	N
M=P・l=	5.8	Ncm
Section factor $Z=bt^2/6$=	0.002	cm^3
σb=M/Z=	24.0	N/mm^2



$\sigma b/fb$= 0.18 <1.0 OK !

20. Ground Foundation

20-1 Without concrete floor

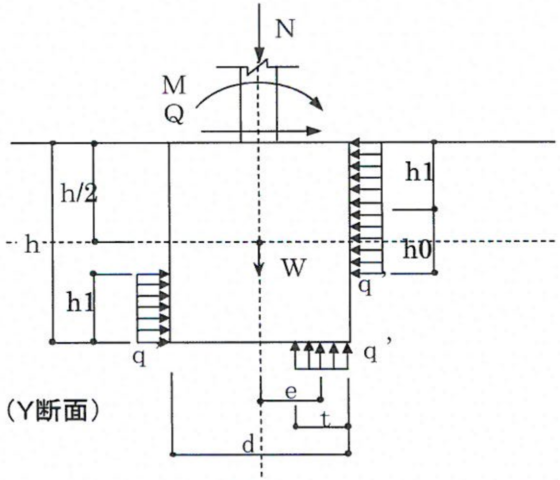
Resistance moment

M_R=(N+W)×e+q's×b×h_1×(h_1+h_0)

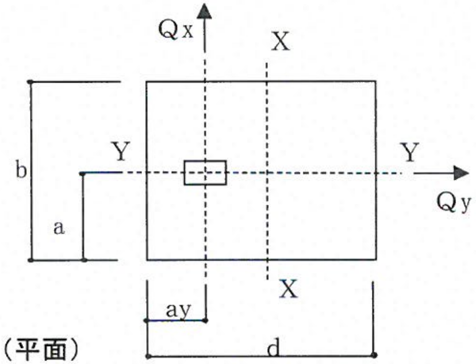
Resistance moment

M=M'+Q*(h/2)−N x (d/2−a)

Base Foundation	
Lateral Pressure	**0.5**
b=	0.90 m
d=	1.10 m
h=	0.55 m
ay=	0.30 m
ax=	0.45 m
Endurance strength of ground Fe=	100 KN/m^2
Short Term Permissible Endurance strength of ground q=	200 KN/m^2
No line concrete Volume weight	22.5 KN/m^3



(Y断面)



(平面)

	Spindle Force(N)	Shear power(N)		Moment(Nm)		Foundation size(m)				Base Weight	Endurance strength of ground	Lateral Pressure
	N	Qx	Qy	M' x	M' y	b	d	h	a	W(N)	q'(kN/m2)	's(kN/m2)=0.5
Long period load	490.8	0.0	0.0	595.4	0.0	0.90	1.10	0.55	0.30	12,251	100	50.0
Short period load	4450.8	0.0	0.0	6548.9	0.0	0.90	1.10	0.55	0.30	12,251	200	100.0
Short term earthquake X	490.8	113.7	0.0	595.4	255.8	0.90	1.10	0.55	0.30	12,251	200	100.0
Short term earthquake Y	490.8	0.0	113.7	851.2	0.0	0.90	1.10	0.55	0.30	12,251	200	100.0
Short period blow down + Holizontal	3293.4	677.5	0.0	4808.8	1524.5	0.90	1.10	0.55	0.30	12,251	200	100.0
Short period blow down + Holizontal	3293.4	0.0	831.6	6679.9	0.0	0.90	1.10	0.55	0.30	12,251	200	100.0
Short period blow up+Holizontal X	−4180.3	677.5	0.0	−6427.1	1524.5	0.90	1.10	0.55	0.30	12,251	200	100.0
Short period blow up+Holizontal Y	−4180.3	0.0	−831.6	−8298.2	0.0	0.90	1.10	0.55	0.30	12,251	200	100.0

■Examination of subsidence (short period snow)

subsidence load		Endurance strength of ground	
N+W (N)	<	b×d×q (N)	
16702		198000	∴OK !

■Examination of uplift (short period blow up)

uplift load		Base weight	
N (N)	<	b×d×h×γ(N)	
4180		12251	∴OK !

	X direction								
	t(m)	e(m)	h0(m)	h1(m)	Resistance MRx	Fall Mx		JUDGMENT	
	(N+W)/(b×q')	(d−t)/2	Qy/(b×q's)	(h−h0)/2	MRx(N・m)	Mx(N・m)	Mx/MRx	MR≧M	
Long period load	0.142	0.479	0.000	0.275	9,509	472.7	0.050	<1.0	OK !
Short period load	0.093	0.504	0.000	0.275	15,217	5436.2	0.357	<1.0	OK !
Short term earthquake X	0.071	0.515	0.000	0.275	13,363	472.7	0.035	<1.0	OK !
Short term earthquake Y	0.071	0.515	0.001	0.274	13,363	759.7	0.057	<1.0	OK !
Short period blow down + Holizontal X	0.086	0.507	0.000	0.275	14,685	3985.5	0.271	<1.0	OK !
Short period blow down + Holizontal Y	0.086	0.507	0.009	0.270	14,683	6085.3	0.414	<1.0	OK !
Short period blow up+Holizontal X	0.045	0.528	0.000	0.275	11,064	−5382.1	0.486	<1.0	OK !
Short period blow up+Holizontal Y	0.045	0.528	0.009	0.270	11,062	−7481.8	0.676	<1.0	OK !

	Y direction								
	t(m)	e(m)	h0(m)	h1(m)	Resistance MRx	Fall Mx		JUDGMENT	
	(N+W)/(d×q')	(b−t)/2	Qx/(d×q's)	(h−h0)/2	MRy(N・m)	My(N・m)	My/Mry	MR≧M	
Short term earthquake X	0.058	0.421	0.001	0.274	12,171	287.1	0.024	<1.0	OK !
Short period blow down + Holizontal X	0.071	0.415	0.006	0.272	13,251	1710.8	0.129	<1.0	OK !
Short period blow up+Holizontal X	0.037	0.432	0.006	0.272	10,289	1710.8	0.166	<1.0	OK !

21-1 With concrete floor

Resistance moment

$M_R=(N+W)\times e+q's\times b\times h_1\times h_1/2$

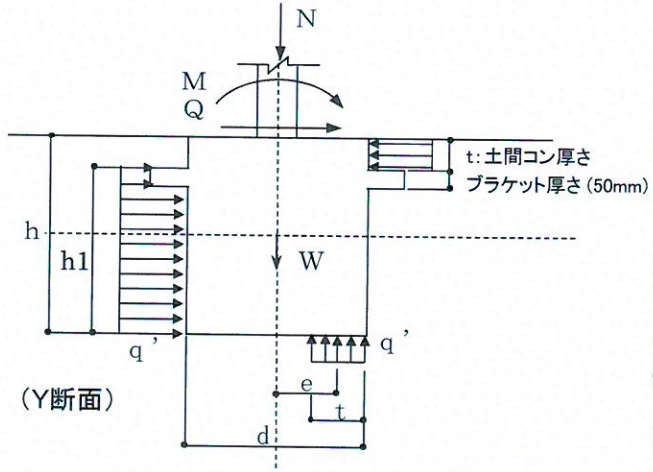
Fall moment

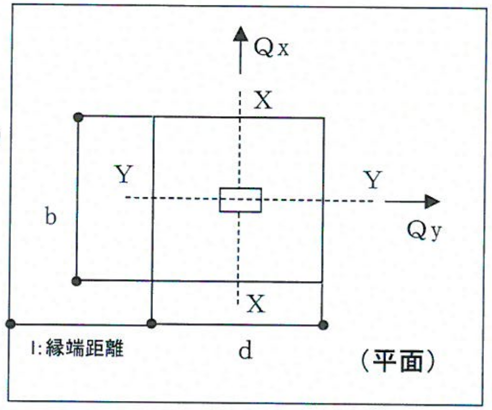
$M=M'+Q*(h/2)$

Base Foundation

Lateral Pressure 0.5

b=	0.60 m
d=	0.45 m
h=	0.55 m
h_1=	0.45 m
l=	0.35 m
Concrete floor thickness t=	0.10 m
Endurance strength of ground Fe=	50 KN/m^2
Short Term Permissible Endurance strength of ground q=	100 KN/m^2
No line concrete Volume weight γ=	22.5 KN/m^3
Concrete standard strength Fc=	15000 KN/m^3





	Spindle Force(N)	Shear power(N)		Moment(Nm)		Foundation size(m)					Base Weight	Endurance strength of ground	Lateral Pressure
	N	Qx	Qy	M'x	M'y	b	d	h	nd part lengt	loor thicknes	W(N)	q'(kN/m2)	's(kN/m2)=0.5c
Long period load	490.8	0.0	0.0	595.4	0.0	0.60	0.45	0.55	0.35	0.10	3,341	50	25.0
Short period load	4450.8	0.0	0.0	6548.9	0.0	0.60	0.45	0.55	0.35	0.10	3,341	100	50.0
Short term earthquake X	490.8	113.7	0.0	595.4	255.8	0.60	0.45	0.55	0.35	0.10	3,341	100	50.0
Short term earthquake Y	490.8	0.0	113.7	851.2	0.0	0.60	0.45	0.55	0.35	0.10	3,341	100	50.0
Short period blow down + Holizontal X	3293.4	677.5	0.0	4808.8	1524.5	0.60	0.45	0.55	0.35	0.10	3,341	100	50.0
Short period blow down + Holizontal Y	3293.4	0.0	831.6	6679.9	0.0	0.60	0.45	0.55	0.35	0.10	3,341	100	50.0
Short period blow up+Holizontal X	-4180.3	677.5	0.0	-6427.1	1524.5	0.60	0.45	0.55	0.35	0.10	3,341	100	50.0
Short period blow up+Holizontal Y	-4180.3	0.0	-831.6	-8298.2	0.0	0.60	0.45	0.55	0.35	0.10	3,341	100	50.0

■Examination of subsidence (short period snow)

subsidence load		Endurance strength of ground
N+W (N)	<	b×d×q (N)
7792		27000

∴OK !

■Concrete floor panchingshere (short term wind blow up)

share force		permissible share force
Q (N)	<	1.5×fs×t×0.9l×2(N)
63068		94500

∴OK !

■Concrete floor bearing capacity (short term wind blow up)

share force		bearing capacity
Q (N)	<	fc×b×0.875t/2(N)
63068		262500

∴OK !

	X direction						
	Vertical load N+W(N)	t(m) (N+W)/(b×q')	e(m) (d-t)/2	Resistance MRx MRx(N·m)	Fall Mx Mx(N·m)	Mx/MRx	JUDGMENT MR≧M
Long period load	3832.0	0.128	0.161	2,136	148.8	0.070	<1.0 OK !
Short period load	7792.0	0.130	0.160	4,285	1637.2	0.382	<1.0 OK !
Short term earthquake X	3832.0	0.064	0.193	3,777	148.8	0.039	<1.0 OK !
Short term earthquake Y	3832.0	0.064	0.193	3,777	215.6	0.057	<1.0 OK !
Short period blow down + Holizontal X	6634.7	0.111	0.170	4,163	1202.2	0.289	<1.0 OK !
Short period blow down + Holizontal Y	6634.7	0.111	0.170	4,163	1690.8	0.406	<1.0 OK !
Short period blow up+Holizontal X	0.0	0.000	0.225	3,038	-1606.8	0.529	<1.0 OK !
Short period blow up+Holizontal Y	0.0	0.000	0.225	3,038	-2095.3	0.690	<1.0 OK !

	Y direction						
	Vertical load N+W(N)	t(m) (N+W)/(b×q')	e(m) (d-t)/2	Resistance MRx MRx(N·m)	Fall Mx Mx(N·m)	Mx/MRx	JUDGMENT MR≧M
Short term earthquake X	3832.0	0.085	0.257	4,024	66.8	0.017	<1.0 OK !
Short period blow down + Holizontal X	6634.7	0.147	0.226	4,539	398.1	0.088	<1.0 OK !
Short period blow up+Holizontal X	0.0	0.000	0.300	3,038	398.1	0.131	<1.0 OK !

159801

5730 - POST

AS1664.1:1997-Aluminimum Structures Part 2: limit state design

Member	beam

T only

Alloy and tamper	Product	Tension		Compression	Shear		Bearing		Modulus of E
		Ftu	Fty	Fcy	Fsu	Fsy	Fbu	Fby	E
6063 T6	Extrusions	207	172	172	131	96	434	276	70000
				180					

Table 3.3(D) Page 20

T5,T6,T7,T8 & T9 only

Type of member stress	Intercept		Slope		Intersection	
Compression in columns and beam flanges	*Bc*	190.112849	*Dc*	0.99075936	*Cc*	78.6732591
Compression in flat plates	*Bp*	216.080333	*Dp*	1.20053227	*Cp*	73.7947145
Compression in round tubes under axial end loads	*Bt*	209.620466	*Dt*	6.71428412	*Ct*	trial and error
Compressive bending stress in solid rectangular bars	*Bbr*	317.096705	*Dbr*	2.61387132	*Cbr*	80.8753674
Compressive bending stress in round tubes	*Btb*	329.59479	*Dtb*	142.532382	*Ctb*	0.78029952
Shear stress in flat plate	*Bs*	120.834478	*Ds*	0.50203881	*Cs*	98.6818859
Ultimate strength of flat plates in compression	*k1*	0.35	*k2*	2.27		
Ultimate strength of flat plates in bending	*k1*	0.5	*k2*	2.04		

Table 3.4 (A) Page 21

Factor of safety	Normal buildings
φy	0.95
φu	0.85
φvp	0.9
φb	0.85
φcp	0.8
φw	0.9
φc	0.85
φv	0.8
φcc	see below

RHS/SHS section properties

Effective Length (m)	2750	mm	between restraints
Height	150	mm	
Width	95	mm	
Walls side (avg if complex shape)	1.6	mm	
Walls top/bottom (average is complex shape)	5.6	mm	CM (CANTAPORT)
Ix	6621600		662.16

Table 3.4 (b) Page 21

kt	1
kc	1.12

Iy	1885900		188.59
J (Torsion constant (warp))	3402000		340.2
Zx	88290		88.29
Zy	39700		39.7
Area	1592		15.92
Radius of gyration Rx	64.49260797	mm	
Radius of gyration Ry	34.41817184	mm	

Bending capacity

3.4.15-Compresion in beams, extreme fibre, gross section - RHS and SHS page 37

Limits (N)	191.7113041		
Zc	88290	Assumed to be Zx	
S1	1.792654179		
S2	2417.766287		
	mpa		
Equ-3.4.15(1): N<S1	163.4	mPa	
Equ-3.4.15(2): S1<N<S	142.9393882	mPa	Add tripple to one formula
Equ-3.4.15(3): S2>N	1196.855281	mPa	

3.4.12 - Compression in beams, extreme fibre, gross section single web beams bent about strong axis Page 35 — **MORE ACCURATE METHOD**

limts (N)	26.5842941	Note Clause Ry=Rye Page 37 Bottom Para	
Rye limit	26.5842941	Rye	103.444537

4.9 compression in single web beams and beams having sections containing tubular portions

Cb	1	Note if Ky<1 = 1	
ky	1		
rye	103.4445372		
S1	-2.570688695		
S2	94.4079109		
Equ-3.4.12(1): N<S1	163.4	mPa	
Equ-3.4.12(2): S1<N<S	142.9393863	mPa	Add tripple to one formula
Equ-3.4.12(3): S2>N	1196.855042	mPa	

3.4.22 Compression in components of bea- flat plates with both edges supported Page 41 **WEBB**

NOTE AMMEND SIDE WALLS FOR ODD SHAPES

Limit (N) (h/t)	86.75		
	138.8		
S1	38.36639146		
S2	90.53212769		
Equ-3.4.22(1): N<S1	190.06		
Equ-3.4.22(2): S1<N<S	140.396174		Add tripple to one formula
Equ-3.4.22(3): S2>N	140.5560979		

140.39 + 88.29

FLANGE

3.4.17 compression in components of beams gross section flat plates Page 38

NOTE AMMEND TO SUIT DIFFERING TOP OR BOTTOM WALLS FOR ODD SHAPES

Limit (N) (b/t)	16.39285714		
H	91.8		Add tripple to one formula
S1	12.41378457		
S2	56.24597143		
Equ-3.4.17(1): N<S1	163.4	mPa	
Equ-3.4.17(2): S1<N<S	156.9032732	mPa	
Equ-3.4.17(3): S2>N	257.1171799	mPa	

Compression capacity

3.4.8.1-Genreal compression

	k	1		
Dc	62.79993051			
S1	0.581870399			
S2	1.241183988			
λx	0.672716031			
λy	1.260532124			
	X-X	y-y		
φcc limits λ<1.2	0.858729633	0.73528825		
φcc limits λ>1.2	0.674180244	0.7564745		
	X-X	Y-Y		
Equ-3.4.8.1 (1) N<s1	131.8763366	112.919268	mPa	
	103.5348232	116.172869	mPa	Red through
Equ-3.4.8.1 (2) s1<n<s	126.9771987	81.581349	mPa	and choise
	99.68855795	83.9319949	mPa	the correct
Equ-3.4.8.1 (3) N>s2	326.37835	79.5936167	mPa	one.
	256.2364535	81.886989	mPa	

79.59 + 159.2

3.4.8.10
Compression flat plates

Webb plates		
H/t See3.4.22	86.75	
S1	23.13644439	
S2	39.37218	
Equ-3.4.17 (1) N<s1	163.4	mPa
Equ-3.4.17 (2) s1<n<s	42.02948511	mPa
Equ-3.4.17 (3) N>s2	48.5865729	mPa
Flange		
H/t See3.4.17	16.39285714	
S1	23.13644439	
S2	39.37218	
Equ-3.4.17 (1) N<s1	163.4	mPa
Equ-3.4.17 (2) s1<n<s	156.9032732	mPa
Equ-3.4.17 (3) N>s2	257.1171799	mPa

5730 Beam

AS1664.1:1997-Aluminimum Structures Part 2: limit state design

Member	beam

T only

Alloy and tamper	Product	Tension		Compression	Shear		Bearing		Modulus of E
		Ftu	Fty	Fcy	Fsu	Fsy	Fbu	Fby	E
6063 T6	Extrusions	207	172	172	131	96	434	276	70000
				180					

Table 3.3(D) Page 20

T5,T6,T7,T8 & T9 only

Type of member stress	Intercept		Slope		Intersection	
Compression in columns and beam flanges	*Bc*	190.112849	*Dc*	0.99075936	*Cc*	78.6732591
Compression in flat plates	*Bp*	216.080333	*Dp*	1.20053227	*Cp*	73.7947145
Compression in round tubes under axial end loads	*Bt*	209.620466	*Dt*	6.71428412	*Ct*	trial and error
Compressive bending stress in solid rectangular bars	*Bbr*	317.096705	*Dbr*	2.61387132	*Cbr*	80.8753674
Compressive bending stress in round tubes	*Btb*	329.59479	*Dtb*	142.532382	*Ctb*	0.78029952
Shear stress in flat plate	*Bs*	120.834478	*Ds*	0.50203881	*Cs*	98.6818859
Ultimate strength of flat plates in compression	*k1*	0.35	*k2*	2.27		
Ultimate strength of flat plates in bending	*k1*	0.5	*k2*	2.04		

Table 3.4 (A) Page 21

Factor of safety	Normal buildings
φy	0.95
φu	0.85
φvp	0.9
φb	0.85
φcp	0.8
φw	0.9
φc	0.85
φv	0.8
φcc	see below

RHS/SHS section properties

Effective Length (m)	3000	mm between restraints
Height	124	mm
Width	67	mm
Walls side (avg if complex shape)	2	mm
Walls top/bottom (average is complex shape)	4.9	mm
Ix	2677900	

CM (CANTAPORT)
267.79

Table 3.4 (b) Page 21

kt	1
kc	1.12

Iy	737800	73.78
J (Torsion constant (warp))	1646000	164.6
Zx	43160	43.16
Zy	22020	22.02
Area	1083	10.83
Radius of gyration Rx	49.72593401 mm	
Radius of gyration Ry	26.10087682 mm	

Bending capacity

3.4.15-Compresion in beams, extreme fibre, gross section - RHS and SHS page 37

Limits (N)	234.9894937	
Zc	43160	Assumed to be Zx
S1	1.792654179	
S2	2417.766287	
	mpa	
Equ-3.4.15(1): N<S1	163.4 mPa	
Equ-3.4.15(2): S1<N<S	140.9406309 mPa	Add tripple to one formula
Equ-3.4.15(3): S2>N	976.4295549 mPa	

140.9 x 43160

3.4.12 - Compression in beams, extreme fibre, gross section single web beams bent about strong axis Page 35 **MORE ACCURATE METHOD**

limts (N)	29.47485103	Note Clause Ry=Rye Page 37 Bottom Para	
Rye limit	29.47485103	Rye	101.781685

4.9 compression in single web beams and beams having sections containing tubular portions

Cb	1	Note if Ky<1 = 1
ky	1	
rye	101.7816849	
S1	-2.570688695	
S2	94.4079109	
Equ-3.4.12(1): N<S1	163.4 mPa	
Equ-3.4.12(2): S1<N<S	140.9108285 mPa	Add tripple to one formula
Equ-3.4.12(3): S2>N	973.6179716 mPa	

3.4.22 Compression in components of bea- flat plates with both edges supported Page 41

WEBB

NOTE AMMEND SIDE WALLS FOR ODD SHAPES

Limit (N) (h/t)	57.1
	114.2
S1	38.36639146
S2	90.53212769

Equ-3.4.22(1): N<S1	190.06	
Equ-3.4.22(2): S1<N<S	184.5331556	Add tripple to one formula
Equ-3.4.22(3): S2>N	213.5418825	

FLANGE

3.4.17 compression in components of beams gross section flat plates Page 38

NOTE AMMEND TO SUIT DIFFERING TOP OR BOTTOM WALLS FOR ODD SHAPES

Limit (N) (b/t)	12.85714286	
H	63	Add tripple to one formula
S1	12.41378457	
S2	56.24597143	

Equ-3.4.17(1): N<S1	163.4	mPa
Equ-3.4.17(2): S1<N<S	162.6761183	mPa
Equ-3.4.17(3): S2>N	327.8244044	mPa

Compression capacity

3.4.8.1-Genreal compression

	k		1
Dc	62.79993051		
S1	0.581870399		
S2	1.241183988		
λx	0.951803567		
λy	1.813323043		
	X-X	y-y	
φcc limits λ<1.2	0.800121251	0.61920216	
φcc limits λ>1.2	0.713252499	0.83386523	

	X-X	Y-Y		
Equ-3.4.8.1 (1) N<s1	122.8757635	95.0917604	mPa	
	109.5352053	128.057874	mPa	Red through
Equ-3.4.8.1 (2) s1<n<s	104.2875249	47.2056744	mPa	and choise
	92.96508208	63.5707896	mPa	the correct
Equ-3.4.8.1 (3) N>s2	151.9111306	32.3899703	mPa	one.
	135.4182175	43.6188237	mPa	

1083 - 63

3.4.8.10
Compression flat plates

Webb plates		
H/t See3.4.22	57.1	
S1	23.13644439	
S2	39.37218	
Equ-3.4.17 (1) N<s1	163.4	mPa
Equ-3.4.17 (2) s1<n<s	90.43974848	mPa
Equ-3.4.17 (3) N>s2	73.81585288	mPa
Flange		
H/t See3.4.17	12.85714286	
S1	23.13644439	
S2	39.37218	
Equ-3.4.17 (1) N<s1	163.4	mPa
Equ-3.4.17 (2) s1<n<s	162.6761183	mPa
Equ-3.4.17 (3) N>s2	327.8244044	mPa

S5733
Column.

AS1664.1:1997-Aluminimum Structures Part 2: limit state design

Member	beam

T only

Alloy and tamper	Product	Tension		Compression	Shear		Bearing		Modulus of E
		Ftu	Fty	Fcy	Fsu	Fsy	Fbu	Fby	E
6063 T6	Extrusions	207	172	172	131	96	434	276	70000
				180					

Table 3.3(D) Page 20

T5,T6,T7,T8 & T9 only

Type of member stress	Intercept		Slope		Intersection	
Compression in columns and beam flanges	*Bc*	190.112849	*Dc*	0.99075936	*Cc*	78.6732591
Compression in flat plates	*Bp*	216.080333	*Dp*	1.20053227	*Cp*	73.7947145
Compression in round tubes under axial end loads	*Bt*	209.620466	*Dt*	6.71428412	*Ct*	trial and error
Compressive bending stress in solid rectangular bars	*Bbr*	317.096705	*Dbr*	2.61387132	*Cbr*	80.8753674
Compressive bending stress in round tubes	*Btb*	329.59479	*Dtb*	142.532382	*Ctb*	0.78029952
Shear stress in flat plate	*Bs*	120.834478	*Ds*	0.50203881	*Cs*	98.6818859
Ultimate strength of flat plates in compression	*k1*	0.35	*k2*	2.27		
Ultimate strength of flat plates in bending	*k1*	0.5	*k2*	2.04		

Table 3.4 (A) Page 21

Factor of safety	Normal buildings
φy	0.95
φu	0.85
φvp	0.9
φb	0.85
φcp	0.8
φw	0.9
φc	0.85
φv	0.8
φcc	see below

RHS/SHS section properties

Effective Length (m)	2750 mm	between restraints
Height	150 mm	
Width	95 mm	
Walls side (avg if complex shape)	1.6 mm	
Walls top/bottom (average is complex shape)	5.6 mm	CM (CANTAPORT)
Ix	6621600	662.16

Table 3.4 (b) Page 21

kt	1
kc	1.12

Iy	1885900	188.59
J (Torsion constant (warp))	3402000	340.2
Zx	88290	88.29
Zy	39700	39.7
Area	1592	15.92
Radius of gyration Rx	64.49260797 mm	
Radius of gyration Ry	34.41817184 mm	

Bending capacity

3.4.15-Compresion in beams, extreme fibre, gross section - RHS and SHS page 37

Limits (N)	191.7113041	
Zc	88290	Assumed to be Zx
S1	1.792654179	
S2	2417.766287	
	mpa	
Equ-3.4.15(1): N<S1	163.4 mPa	
Equ-3.4.15(2): S1<N<S	142.9393882 mPa	Add tripple to one formula
Equ-3.4.15(3): S2>N	1196.855281 mPa	

K+0.39 + 88290

3.4.12 - Compression in beams, extreme fibre, gross section single web beams bent about strong axis Page 35 **MORE ACCURATE METHOD**

limts (N)	26.5842941	Note Clause Ry=Rye Page 37 Bottom Para	
Rye limit	26.5842941	Rye	103.444537

4.9 compression in single web beams and beams having sections containing tubular portions

Cb	1	Note if Ky<1 = 1
ky	1	
rye	103.4445372	
S1	-2.570688695	
S2	94.4079109	
Equ-3.4.12(1): N<S1	163.4 mPa	
Equ-3.4.12(2): S1<N<S	142.9393863 mPa	Add tripple to one formula
Equ-3.4.12(3): S2>N	1196.855042 mPa	

3.4.22 Compression in components of bea- flat plates with both edges supported Page 41

WEBB

NOTE AMMEND SIDE WALLS FOR ODD SHAPES

Limit (N) (h/t)	86.75	
	138.8	
S1	38.36639146	
S2	90.53212769	
Equ-3.4.22(1): N<S1	190.06	
Equ-3.4.22(2): S1<N<S	140.396174	Add tripple to one formula
Equ-3.4.22(3): S2>N	140.5560979	

FLANGE

3.4.17 compression in components of beams gross section flat plates Page 38

NOTE AMMEND TO SUIT DIFFERING TOP OR BOTTOM WALLS FOR ODD SHAPES

Limit (N) (b/t)	16.39285714		
H	91.8		Add tripple to one formula
S1	12.41378457		
S2	56.24597143		
Equ-3.4.17(1): N<S1	163.4	mPa	
Equ-3.4.17(2): S1<N<S	156.9032732	mPa	
Equ-3.4.17(3): S2>N	257.1171799	mPa	

Compression capacity

3.4.8.1-Genreal compression

	k	1		
Dc	62.79993051			
S1	0.581870399			
S2	1.241183988			
λx	0.672716031			
λy	1.260532124			
	X-X	y-y		
φcc limits λ<1.2	0.858729633	0.73528825		
φcc limits λ>1.2	0.674180244	0.7564745		
	X-X	Y-Y		
Equ-3.4.8.1 (1) N<s1	131.8763366	112.919268	mPa	
	103.5348232	116.172869	mPa	Red through
Equ-3.4.8.1 (2) s1<n<s	126.9771987	81.581349	mPa	and choise
	99.68855795	83.9319949	mPa	the correct
Equ-3.4.8.1 (3) N>s2	326.37835	79.5936167	mPa	one.
	256.2364535	81.886989	mPa	

81.58 - 1592

3.4.8.10
Compression flat plates

Webb plates

H/t See3.4.22	86.75	
S1	23.13644439	
S2	39.37218	
Equ-3.4.17 (1) N<s1	163.4	mPa
Equ-3.4.17 (2) s1<n<s	42.02948511	mPa
Equ-3.4.17 (3) N>s2	48.5865729	mPa

Flange

H/t See3.4.17	16.39285714	
S1	23.13644439	
S2	39.37218	
Equ-3.4.17 (1) N<s1	163.4	mPa
Equ-3.4.17 (2) s1<n<s	156.9032732	mPa
Equ-3.4.17 (3) N>s2	257.1171799	mPa

5730
Beam

AS1664.1:1997-Aluminimum Structures Part 2: limit state design

Member **beam**

T only

Alloy and tamper	Product	Tension		Compression	Shear		Bearing		Modulus of E
		Ftu	Fty	Fcy	Fsu	Fsy	Fbu	Fby	E
6063 T6	Extrusions	207	172	172	131	96	434	276	70000
				180					

Table 3.3(D) Page 20

T5,T6,T7,T8 & T9 only

Type of member stress	Intercept		Slope		Intersection	
Compression in columns and beam flanges	*Bc*	190.112849	*Dc*	0.99075936	*Cc*	78.6732591
Compression in flat plates	*Bp*	216.080333	*Dp*	1.20053227	*Cp*	73.7947145
Compression in round tubes under axial end loads	*Bt*	209.620466	*Dt*	6.71428412	*Ct*	trial and error
Compressive bending stress in solid rectangular bars	*Bbr*	317.096705	*Dbr*	2.61387132	*Cbr*	80.8753674
Compressive bending stress in round tubes	*Btb*	329.59479	*Dtb*	142.532382	*Ctb*	0.78029952
Shear stress in flat plate	*Bs*	120.834478	*Ds*	0.50203881	*Cs*	98.6818859
Ultimate strength of flat plates in compression	*k1*	0.35	*k2*	2.27		
Ultimate strength of flat plates in bending	*k1*	0.5	*k2*	2.04		

Table 3.4 (A) Page 21

Factor of safety	Normal buildings
φy	0.95
φu	0.85
φvp	0.9
φb	0.85
φcp	0.8
φw	0.9
φc	0.85
φv	0.8
φcc	see below

Table 3.4 (b) Page 21

kt	1
kc	1.12

RHS/SHS section properties

Effective Length (m)	3300 mm between restraints	
Height	124 mm	
Width	67 mm	
Walls side (avg if complex shape)	2 mm	
Walls top/bottom (average is complex shape)	4.9 mm	CM (CANTAPORT)
Ix	2677900	267.79

Iy	737800	73.78
J (Torsion constant (warp))	1646000	164.6
Zx	43160	43.16
Zy	22020	22.02
Area	1083	10.83
Radius of gyration Rx	49.72593401 mm	
Radius of gyration Ry	26.10087682 mm	

Bending capacity

3.4.15-Compresion in beams, extreme fibre, gross section - RHS and SHS page 37

Limits (N)	258.488443		
Zc	43160	Assumed to be Zx	
S1	1.792654179		
S2	2417.766287		
	mpa		
Equ-3.4.15(1): N<S1	163.4	mPa	
Equ-3.4.15(2): S1<N<S	139.9324699	mPa	Add tripple to one formula
Equ-3.4.15(3): S2>N	887.6632317	mPa	

139.89 × 43160

3.4.12 - Compression in beams, extreme fibre, gross section single web beams bent about strong axis Page 35 **MORE ACCURATE METHOD**

limts (N)	30.92021187	Note Clause Ry=Rye Page 37 Bottom Para	
Rye limit	30.92021187	Rye	106.726306

4.9 compression in single web beams and beams having sections containing tubular portions

Cb	1	Note if Ky<1 = 1	
ky	1		
rye	106.7263062		
S1	-2.570688695		
S2	94.4079109		
Equ-3.4.12(1): N<S1	163.4	mPa	
Equ-3.4.12(2): S1<N<S	139.8964918	mPa	Add tripple to one formula
Equ-3.4.12(3): S2>N	884.722143	mPa	

3.4.22 Compression in components of bea- flat plates with both edges supported Page 41

WEBB

NOTE AMMEND SIDE WALLS FOR ODD SHAPES

Limit (N) (h/t)	57.1
	114.2
S1	38.36639146
S2	90.53212769
Equ-3.4.22(1): N<S1	190.06
Equ-3.4.22(2): S1<N<S	184.5331556
Equ-3.4.22(3): S2>N	213.5418825

Add tripple to one formula

FLANGE

3.4.17 compression in components of beams gross section flat plates Page 38

NOTE AMMEND TO SUIT DIFFERING TOP OR BOTTOM WALLS FOR ODD SHAPES

Limit (N) (b/t)	12.85714286	
H	63	
S1	12.41378457	
S2	56.24597143	
Equ-3.4.17(1): N<S1	163.4	mPa
Equ-3.4.17(2): S1<N<S	162.6761183	mPa
Equ-3.4.17(3): S2>N	327.8244044	mPa

Add tripple to one formula

Compression capacity

3.4.8.1-Genreal compression

	k	1	
Dc	62.79993051		
S1	0.581870399		
S2	1.241183988		
λx	1.046983924		
λy	1.994655347		
	X-X	y-y	
φcc limits λ<1.2	0.780133376	0.58112238	
φcc limits λ>1.2	0.726577749	0.85925175	
	X-X	Y-Y	
Equ-3.4.8.1 (1) N<s1	119.806197	89.2437936	mPa
	111.5815829	131.956519	mPa
Equ-3.4.8.1 (2) s1<n<s	97.01920554	37.6849912	mPa
	90.35890295	55.7213005	mPa
Equ-3.4.8.1 (3) N>s2	122.4101073	25.1223531	mPa
	114.0067366	37.1460929	mPa

Red through and choise the correct one.

37.68 × 1093

3.4.8.10
Compression flat plates

Webb plates		
H/t See3.4.22	57.1	
S1	23.13644439	
S2	39.37218	
Equ-3.4.17 (1) N<s1	163.4	mPa
Equ-3.4.17 (2) s1<n<s	90.43974848	mPa
Equ-3.4.17 (3) N>s2	73.81585288	mPa
Flange		
H/t See3.4.17	12.85714286	
S1	23.13644439	
S2	39.37218	
Equ-3.4.17 (1) N<s1	163.4	mPa
Equ-3.4.17 (2) s1<n<s	162.6761183	mPa
Equ-3.4.17 (3) N>s2	327.8244044	mPa

4. HAND CALCULATIONS

ADDRESS:	PROJ #: D105116	DES:	DATE: 12 / 9 / 16
CLIENT:	SHT #: 1 of ___	CHK:	DATE: 12 / 9 / 16

CALCULATION: PJR Replacement to KCR. — COMMENTS / REF

The Following Calc's are a Replacement to the KCR units Previously Completed By this office.

Site wind speed.

VSite = VRMD (MZcat, MS, Mt)

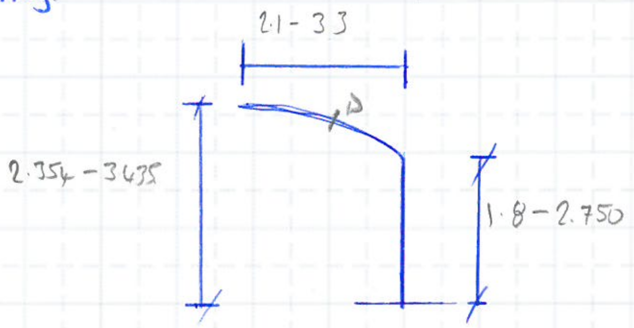
Region A = 41m/s

MD, MS, Mt = 1.0   MZ = 0.91

| 0.91 × 41 = 0.933 kN/m² Chg.

Chg.

D = 46 + 124 = 170



M		θ	A	θ (Tan O/A)
θ = 1.8 − 2.354 = 0.554			2100	10.36°
1.8 − 2.442 = 0.642	−170		2700	9.91
1.8 − 2.449 = 0.649			3000	9.07
1.8 − 2.485 = 0.685			3300	8.97°

Avg = 9.55° Say 10

Note very Shallow Radius.

As with Previous calcs Empty under.

				B/h
0.277		2100		
0.554/2 +	1.8	= 2.077		= 0.98
	2.250	= 2.527	2100	= 1.20
	2.750	= 3.027		= 1.44
.321		2700		
.642/2 +	1.8	= 2.121		= 0.78
	2.250	= 2.571	2700	= 0.95
	2.750	= 3.071		= 1.12
.324		3000		
.649/2 +	1.8	= 2.12		= 0.70
	2.250	= 2.574	3000	= 0.858
	2.750	= 3.074		= 1.22
0.342		3300		
.685/2 +	1.8	= 2.142		= 0.64
	2.250	= 2.592	3300	= 0.78
	2.750	= 3.092.		= 0.93

No Point Load or vehicle Impacts.

Use the D4(A)

Net wind. kN/m²

θ = 0°
Cpw = −.77 = 0.641 ↑
Cpl = −.53 = 0.44 ↑

θ = 180°
Cpw = 0.43 = 0.35 ↓
Cpl = 0.13 = 0.108. ↓

Barn type Tbl D5
θ = 0
Cpw = −0.3 = 0.269 ↑
0.4 = 0.333 ↓.
Cpl = −0.4 = −0.333 ↑

Dead = 0.1
Live = 0.25 kN/m².

ADDRESS:	PROJ #: D10514	DES:	DATE: 12/9/16
CLIENT:	SHT #: 2 of ___	CHK:	DATE: __/__/__

CALCULATION: Purlin forces. | COMMENTS / REF

Max Frame forces

(A) D+L = 0.1×1.2 + 0.25×1.5 = 0.495 kN/m² ↓

(B) D+WA = 0.1×0.9 − 0.641 = 0.551 ↑

(C) D+Wd = 0.1×1.2 + 0.35 = 0.47 ↓

Purlin L/W A 0.645 Span 2000 OH 871
or
B 0.585 3000 1221.

A OH = $\frac{0.35 \times 0.871^2}{2}$ = 0.13
Mmin = $\frac{0.35 \times 2.0^2}{8}$ = 0.175
} median = 0.32 kN.m

B OH =
@ $\frac{0.32 \times 1.221^2}{2}$ = 0.23 kN.m
Mmin = $\frac{0.32 \times 3.3^2}{8}$ = 0.43
Middle mom Allow. 0.319'
} median 0.36 kN.m OK

STRUCterre consulting engineers

Residential | Geotechnical | Commercial & Infrastructure | Inspect & Investigate | Energy Assessment | Environmental

ADDRESS:	PROJ #: D105116	DES:	DATE: 1 / 12 / 16
CLIENT:	SHT #: 2a of ___	CHK:	DATE: ___ / ___ / ___

CALCULATION: | COMMENTS / REF

See KCR - PJR _ _ _ _

Stake Report	Post	Beam
4330	DE8388	DE 8393
4333	DE 8387	DE 8392
5021	DE 8386	DE 8390
5030	DE 8389	DE 8391
5033	DE 8388	DE 8393
5730	DE 8389	DE 8394
5733	DE 8389	DE 8394

Summary Cal's

	Post		Beam
4033	8.63	kNm	4.11
	104	kN	29
50.33	10.38		5.19
	116		33
5733	12.39		6.03
	129		40.15
5730	12.39		6.08
	126		68.2
4330	10.38		5.23
	118		42
5030	12.39		5.23
	129		42.

544 , 0.233 (750)

STRUCterre consulting engineers

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ADDRESS:	PROJ #: D105116	DES:	DATE: 1 / 12 / 16
CLIENT:	SHT #: 3 of ___	CHK:	DATE: ___ / ___ / ___

CALCULATION: Main Frame D3000 — COMMENTS / REF

Cantilever 3000 Post 2750.

$L/w = \frac{3.3}{2} + 1.221 = 2.871m$

Repeats 4330 5033 5733

kN/m.

CASE A = 0.495 = 1.42 ↓

B = 2.871 × 0.551 = 1.58 ↑

C = 0.47 = 1.34 ↓.

Multi Frame Results

Beams.		BM	SF	Axial.
CASE	A	6.655	4.334	0.372 C
	B	7.04	4.59	0.37 T
	C	6.28	4.09	0.39 C
Post	A	9.068	0.87	4.28 C
	B	10.09	0.97	4.73 T
	C	8.58	0.82	4.01 C.

Increase Inner Sleeve to 750mm. Double Beam.

Post main 10.394kNm Conservative

Detail Beam Cal's

4330

Beam = $-0.551 \times (\frac{1.3}{2} + 0.856) = 0.82 \frac{(3300 - 0.150 - 0.484)^2}{2}$ (2.66) $= 2.914$ kN.m < 4.11 ok

5033

Beam = $-0.551 \times (\frac{1.775}{2} + 778) = 0.89 \frac{\times 2.66^2}{2}$ = 3.16 kN.m < 5.19

5733

Beam = $-0.551 (\frac{2.0}{2} + 0.871) = 1.03 \frac{\times 2.66^2}{2}$ = 3.64 kN.m < 6.03 kN.m

STRUCterre consulting engineers

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ADDRESS:	PROJ #: D105116	DES:	DATE: 1 / 12 / 16
CLIENT:	SHT #: 4 of ___	CHK:	DATE: ___ / ___ / ___

CALCULATION: Main frame 3000 | COMMENTS / REF

Cantiler 3300 Post 2750

L/W $\frac{2.000}{2} + 0.871 = 1.871$ m

Reports
4330
5030
5730

kN/m

CASE A = 0.495 = 0.926 ↓

B = 1.871 × 0.551 = 1.03 ↑

C = 0.41 = 0.76 ↓

Multi frame Results.

Beams		Bm	SF	Axial.
	A	5.24	3.10	0.26C
	B	5.8	3.4	0.29T
	C	4.31	2.48	0.21C
Posts	A	6.914	0.69	3.05C
	B	7.69	0.6	3.98
	C	5.67	0.49	2.5C

Post 8.63 kN.m via no Rotation for base

4330
Beam = −0.551 × ($\frac{26}{2}$ + 0.550) 1.18 + $\frac{\times\ 2.36^2}{2}$ (3 − 0.150 − 0.090) = 3.33 < 5.27 kN.m.

5030
Beam = −0.551 × ($\frac{2.9}{2}$ + 0.063 = 1.38 $\frac{\times 2.36}{2}$ = 3.85 < 5.27

5730
Beam = −0.551 ($\frac{3.36}{2}$ + 1.221 = 1.58 $\frac{\times}{2}$ = 4.40 < 6.08 kN.m

Footing 10.09 kN.m

0.8 × 1.1 × 1.1 × 24 × $\frac{6.1}{2}$ × 0.9 = 11.49 kN.m

Pile capacity = $\frac{0.5 \times 0.9 \times 2.1^3 \times .33 \times 17}{2.750 + 2.1}$ = 4.92 kN. F = $\frac{10.09}{2.75}$ = 3.70 kN OK ✓

5. PURLINS

AS1664.1:1997-Aluminimum Structures Part 2: limit state design

Member	beam

T only

Alloy and tamper	Product	Tension		Compression	Shear		Bearing		Modulus of E
		Ftu	Fty	Fcy	Fsu	Fsy	Fbu	Fby	E
6063 T6	Extrusions	207	172	172	131	96	434	276	70000
				180					

Table 3.3(D) Page 20

T5,T6,T7,T8 & T9 only

Type of member stress	Intercept		Slope		Intersection	
Compression in columns and beam flanges	*Bc*	190.112849	*Dc*	0.99075936	*Cc*	78.6732591
Compression in flat plates	*Bp*	216.080333	*Dp*	1.20053227	*Cp*	73.7947145
Compression in round tubes under axial end loads	*Bt*	209.620466	*Dt*	6.71428412	*Ct*	trial and error
Compressive bending stress in solid rectangular bars	*Bbr*	317.096705	*Dbr*	2.61387132	*Cbr*	80.8753674
Compressive bending stress in round tubes	*Btb*	329.59479	*Dtb*	142.532382	*Ctb*	0.78029952
Shear stress in flat plate	*Bs*	120.834478	*Ds*	0.50203881	*Cs*	98.6818859
Ultimate strength of flat plates in compression	*k1*	0.35	*k2*	2.27		
Ultimate strength of flat plates in bending	*k1*	0.5	*k2*	2.04		

Table 3.4 (A) Page 21

Factor of safety	Normal buildings
φy	0.95
φu	0.85
φvp	0.9
φb	0.85
φcp	0.8
φw	0.9
φc	0.85
φv	0.8
φcc	see below

RHS/SHS section properties

Effective Length (m)	3300 mm between restraints	
Height	46 mm	
Width	25 mm	
Walls side (avg if complex shape)	0.9 mm	
Walls top/bottom (average is complex shape)	1.1 mm	CM (CANTAPORT)
Ix	58000	5.8

Table 3.4 (b) Page 21

kt	1
kc	1.12

Iy	21300	2.13
J (Torsion constant (warp))	33000	3.3
Zx	2510	2.51
Zy	930	0.93
Area	175	1.75
Radius of gyration Rx	18.2051798 mm	
Radius of gyration Ry	11.03241976 mm	

Bending capacity

3.4.15-Compresion in beams, extreme fibre, gross section - RHS and SHS page 37

Limits (N)	624.8429662		
Zc	2510	Assumed to be Zx	
S1	1.792654179		
S2	2417.766287		
	mpa		
Equ-3.4.15(1): N<S1	163.4	mPa	
Equ-3.4.15(2): S1<N<S	127.9143355	mPa	Add tripple to one formula
Equ-3.4.15(3): S2>N	367.2133626	mPa	

3.4.12 - Compression in beams, extreme fibre, gross section single web beams bent about strong axis Page 35 **MORE ACCURATE METHOD**

127 × 2510

limts (N)	48.11371833	Note Clause Ry=Rye Page 37 Bottom Para	
Rye limit	48.11371833	Rye	68.5875071

4.9 compression in single web beams and beams having sections containing tubular portions

Cb	1	Note if Ky<1 = 1	
ky	1		
rye	68.58750715		
S1	-2.570688695		
S2	94.4079109		
Equ-3.4.12(1): N<S1	163.4	mPa	
Equ-3.4.12(2): S1<N<S	127.8302973	mPa	Add tripple to one formula
Equ-3.4.12(3): S2>N	365.3877444	mPa	

3.4.22 Compression in components of bea- flat plates with both edges supported Page 41

WEBB

NOTE AMMEND SIDE WALLS FOR ODD SHAPES

Limit (N) (h/t)	48.66666667	
	43.8	
S1	38.36639146	
S2	90.53212769	
Equ-3.4.22(1): N<S1	190.06	
Equ-3.4.22(2): S1<N<!	197.0870132	Add tripple to one formula
Equ-3.4.22(3): S2>N	250.5460581	

FLANGE

3.4.17 compression in components of beams gross section flat plates Page 38

NOTE AMMEND TO SUIT DIFFERING TOP OR BOTTOM WALLS FOR ODD SHAPES

Limit (N) (b/t)	21.09090909		
H	23.2		Add tripple to one formula
S1	12.41378457		
S2	56.24597143		
Equ-3.4.17(1): N<S1	163.4	mPa	
Equ-3.4.17(2): S1<N<!	149.2326515	mPa	
Equ-3.4.17(3): S2>N	199.8436948	mPa	

Compression capacity

3.4.8.1-Genreal compression

	k	1		
Dc	62.79993051			
S1	0.581870399			
S2	1.241183988			
λx	2.859749483			
λy	4.719023991			
	X-X	y-y		
φcc limits λ<1.2	0.399452609	0.00900496		
φcc limits λ>1.2	0.95	0.95		
	X-X	Y-Y		
Equ-3.4.8.1 (1) N<s1	61.34450774	1.38290487	mPa	
	145.8928571	145.892857	mPa	Red through and choise the correct one.
Equ-3.4.8.1 (2) s1<n<!	4.202553166	-0.9567009	mPa	
	9.99474136	-100.92945	mPa	
Equ-3.4.8.1 (3) N>s2	8.401130445	0.06955141	mPa	
	19.98002705	7.33749269	mPa	

3.4.8.10
Compression flat plates

Webb plates		
H/t See3.4.22	48.66666667	
S1	23.13644439	
S2	39.37218	
Equ-3.4.17 (1) N<s1	163.4	mPa
Equ-3.4.17 (2) s1<n<s	104.2090533	mPa
Equ-3.4.17 (3) N>s2	86.60723012	mPa
Flange		
H/t See3.4.17	21.09090909	
S1	23.13644439	
S2	39.37218	
Equ-3.4.17 (1) N<s1	163.4	mPa
Equ-3.4.17 (2) s1<n<s	149.2326515	mPa
Equ-3.4.17 (3) N>s2	199.8436948	mPa

AS1664.1:1997-Aluminimum Structures Part 2: limit state design

Member	beam

T only

Alloy and tamper	Product	Tension		Compression	Shear		Bearing		Modulus of E
		Ftu	Fty	Fcy	Fsu	Fsy	Fbu	Fby	E
6063 T6	Extrusions	207	172	172	131	96	434	276	70000
				180					

Table 3.3(D) Page 20

T5,T6,T7,T8 & T9 only

Type of member stress	Intercept		Slope		Intersection	
Compression in columns and beam flanges	*Bc*	190.112849	*Dc*	0.99075936	*Cc*	78.6732591
Compression in flat plates	*Bp*	216.080333	*Dp*	1.20053227	*Cp*	73.7947145
Compression in round tubes under axial end loads	*Bt*	209.620466	*Dt*	6.71428412	*Ct*	trial and error
Compressive bending stress in solid rectangular bars	*Bbr*	317.096705	*Dbr*	2.61387132	*Cbr*	80.8753674
Compressive bending stress in round tubes	*Btb*	329.59479	*Dtb*	142.532382	*Ctb*	0.78029952
Shear stress in flat plate	*Bs*	120.834478	*Ds*	0.50203881	*Cs*	98.6818859
Ultimate strength of flat plates in compression	*k1*	0.35	*k2*	2.27		
Ultimate strength of flat plates in bending	*k1*	0.5	*k2*	2.04		

Table 3.4 (A) Page 21

Factor of safety	Normal buildings
φy	0.95
φu	0.85
φvp	0.9
φb	0.85
φcp	0.8
φw	0.9
φc	0.85
φv	0.8
φcc	see below

RHS/SHS section properties		
Effective Length (m)	2750 mm	between restraints
Height	150 mm	
Width	95 mm	
Walls side (avg if complex shape)	1.6 mm	
Walls top/bottom (average is complex shape)	3.4 mm	CM (CANTAPORT)
Ix	4750400	475.04

Table 3.4 (b) Page 21

kt	1
kc	1.12

Iy	1610200		161.02
J (Torsion constant (warp))	3148000		314.8
Zx	63340		63.34
Zy	33900		33.9
Area	1215		12.15
Radius of gyration Rx	62.52834748	mm	
Radius of gyration Ry	36.40422351	mm	

Bending capacity

3.4.15-Compresion in beams, extreme fibre, gross section - RHS and SHS page 37

Limits (N)	154.7331887	
Zc	63340	Assumed to be Zx
S1	1.792654179	
S2	2417.766287	
	mpa	
Equ-3.4.15(1): N<S1	163.4	mPa
Equ-3.4.15(2): S1<N<S	144.834964	mPa
Equ-3.4.15(3): S2>N	1482.879585	mPa

3.4.12 - Compression in beams, extreme fibre, gross section single web beams bent about strong axis Page 35 **MORE ACCURATE METHOD**

limts (N)	23.88818404	Note Clause Ry=Rye Page 37 Bottom Para	
Rye limit	23.88818404	Rye	115.119676

4.9 compression in single web beams and beams having sections containing tubular portions

Cb	1	Note if Ky<1 = 1
ky	1	
rye	115.1196757	
S1	-2.570688695	
S2	94.4079109	
Equ-3.4.12(1): N<S1	163.4	mPa
Equ-3.4.12(2): S1<N<S	144.8314837	mPa
Equ-3.4.12(3): S2>N	1482.263951	mPa

3.4.22 Compression in components of bea- flat plates with both edges supported Page 41

WEBB

NOTE AMMEND SIDE WALLS FOR ODD SHAPES

Limit (N) (h/t)	89.5
	143.2
S1	38.36639146
S2	90.53212769
Equ-3.4.22(1): N<S1	190.06
Equ-3.4.22(2): S1<N<!	136.3025247
Equ-3.4.22(3): S2>N	136.2373351

FLANGE

3.4.17 compression in components of beams gross section flat plates Page 38

NOTE AMMEND TO SUIT DIFFERING TOP OR BOTTOM WALLS FOR ODD SHAPES

Limit (N) (b/t)	27	
H	91.8	
S1	12.41378457	
S2	56.24597143	
Equ-3.4.17(1): N<S1	163.4	mPa
Equ-3.4.17(2): S1<N<!	139.5847376	mPa
Equ-3.4.17(3): S2>N	156.1068592	mPa

Compression capacity

3.4.8.1-Genreal compression

	k		1
Dc	62.79993051		
S1	0.581870399		
S2	1.241183988		
λx	0.693848678		
λy	1.191763127		
	X-X	y-y	
φcc limits λ<1.2	0.854291778	0.74972974	
φcc limits λ>1.2	0.677138815	0.74684684	

	X-X	Y-Y		
Equ-3.4.8.1 (1) N<s1	131.1948087	115.137068	mPa	
	103.9891752	114.694336	mPa	Red through and choise the correct one.
Equ-3.4.8.1 (2) s1<n<!	125.187234	86.4215032	mPa	
	99.22738052	86.0891901	mPa	
Equ-3.4.8.1 (3) N>s2	305.2144862	90.7931949	mPa	
	241.9227025	90.4440715	mPa	

3.4.8.10
Compression flat plates

Webb plates

H/t See3.4.22	89.5	
S1	23.13644439	
S2	39.37218	
Equ-3.4.17 (1) N<s1	163.4	mPa
Equ-3.4.17 (2) s1<n<s	37.53949441	mPa
Equ-3.4.17 (3) N>s2	47.09368938	mPa

Flange

H/t See3.4.17	27	
S1	23.13644439	
S2	39.37218	
Equ-3.4.17 (1) N<s1	163.4	mPa
Equ-3.4.17 (2) s1<n<s	139.5847376	mPa
Equ-3.4.17 (3) N>s2	156.1068592	mPa

3300
Purlin.
Sam Kram

AS1664.1:1997-Aluminimum Structures Part 2: limit state design

Member	beam

T only

Alloy and tamper	Product	Tension		Compression	Shear		Bearing		Modulus of E
		Ftu	Fty	Fcy	Fsu	Fsy	Fbu	Fby	E
6063 T6	Extrusions	207	172	172	131	96	434	276	70000
				180					

Table 3.3(D) Page 20

T5,T6,T7,T8 & T9 only

Type of member stress	Intercept		Slope		Intersection	
Compression in columns and beam flanges	*Bc*	190.112849	*Dc*	0.99075936	*Cc*	78.6732591
Compression in flat plates	*Bp*	216.080333	*Dp*	1.20053227	*Cp*	73.7947145
Compression in round tubes under axial end loads	*Bt*	209.620466	*Dt*	6.71428412	*Ct*	trial and error
Compressive bending stress in solid rectangular bars	*Bbr*	317.096705	*Dbr*	2.61387132	*Cbr*	80.8753674
Compressive bending stress in round tubes	*Btb*	329.59479	*Dtb*	142.532382	*Ctb*	0.78029952
Shear stress in flat plate	*Bs*	120.834478	*Ds*	0.50203881	*Cs*	98.6818859
Ultimate strength of flat plates in compression	*k1*	0.35	*k2*	2.27		
Ultimate strength of flat plates in bending	*k1*	0.5	*k2*	2.04		

Table 3.4 (A) Page 21

Factor of safety	Normal buildings
φy	0.95
φu	0.85
φvp	0.9
φb	0.85
φcp	0.8
φw	0.9
φc	0.85
φv	0.8
φcc	see below

RHS/SHS section properties

Effective Length (m)	1300 mm between restraints	
Height	46 mm	
Width	25 mm	
Walls side (avg if complex shape)	0.9 mm	
Walls top/bottom (average is complex shape)	1 mm	CM (CANTAPORT)
Ix	53300	5.33

Table 3.4 (b) Page 21

kt	1
kc	1.12

Iy	20700	2.07
J (Torsion constant (warp))	32000	3.2
Zx	2270	2.27
Zy	910	0.91
Area	164	1.64
Radius of gyration Rx	18.02775638 mm	
Radius of gyration Ry	11.23474576 mm	

Bending capacity

3.4.15-Compresion in beams, extreme fibre, gross section - RHS and SHS page 37

Limits (N)	229.3184741		
Zc	2270	Assumed to be Zx	
S1	1.792654179		
S2	2417.766287		
	mpa		
Equ-3.4.15(1): N<S1	163.4	mPa	
Equ-3.4.15(2): S1<N<(	141.1913909	mPa	Add tripple to one formula
Equ-3.4.15(3): S2>N	1000.576546	mPa	

141 x 2270

0.32.

MORE ACCURATE METHOD

3.4.12 - Compression in beams, extreme fibre, gross section single web beams bent about strong axis Page 35

limts (N)	29.11491648	Note Clause Ry=Rye Page 37 Bottom Para	
Rye limit	29.11491648	Rye	44.6506519

4.9 compression in single web beams and beams having sections containing tubular portions

Cb	1	Note if Ky<1 = 1	
ky	1		
rye	44.65065188		
S1	-2.570688695		
S2	94.4079109		
Equ-3.4.12(1): N<S1	163.4	mPa	
Equ-3.4.12(2): S1<N<(	141.1634262	mPa	Add tripple to one formula
Equ-3.4.12(3): S2>N	997.8395699	mPa	

3.4.22 Compression in components of bea- flat plates with both edges supported Page 41 **WEBB**

NOTE AMMEND SIDE WALLS FOR ODD SHAPES

Limit (N) (h/t)	48.88888889	
	44	
S1	38.36639146	
S2	90.53212769	
Equ-3.4.22(1): N<S1	190.06	
Equ-3.4.22(2): S1<N<S	196.7562133	Add tripple to one formula
Equ-3.4.22(3): S2>N	249.4072123	

FLANGE

3.4.17 compression in components of beams gross section flat plates Page 38

NOTE AMMEND TO SUIT DIFFERING TOP OR BOTTOM WALLS FOR ODD SHAPES

Limit (N) (b/t)	23.2		
H	23.2		Add tripple to one formula
S1	12.41378457		
S2	56.24597143		
Equ-3.4.17(1): N<S1	163.4	mPa	
Equ-3.4.17(2): S1<N<S	145.7890884	mPa	
Equ-3.4.17(3): S2>N	181.6760862	mPa	

Compression capacity

3.4.8.1-Genreal compression

	k	1		
Dc	62.79993051			
S1	0.581870399			
S2	1.241183988			
λx	1.1376553			
λy	1.825530639			
	X-X	y-y		
φcc limits λ<1.2	0.761092387	0.61663857		
φcc limits λ>1.2	0.739271742	0.83557429		
	X-X	Y-Y		
Equ-3.4.8.1 (1) N<s1	116.8820451	94.6980655	mPa	
	113.5310175	128.320337	mPa	Red through
Equ-3.4.8.1 (2) s1<n<s	90.31744486	46.5374979	mPa	and choise
	87.72802875	63.0605008	mPa	the correct
Equ-3.4.8.1 (3) N>s2	101.1450039	31.8259134	mPa	one.
	98.2451599	43.1256111	mPa	

3.4.8.10 Compression flat plates

Webb plates

H/t See3.4.22	48.88888889	
S1	23.13644439	
S2	39.37218	
Equ-3.4.17 (1) N<s1	163.4	mPa
Equ-3.4.17 (2) s1<n<s	103.8462258	mPa
Equ-3.4.17 (3) N>s2	86.21356089	mPa

Flange

H/t See3.4.17	23.2	
S1	23.13644439	
S2	39.37218	
Equ-3.4.17 (1) N<s1	163.4	mPa
Equ-3.4.17 (2) s1<n<s	145.7890884	mPa
Equ-3.4.17 (3) N>s2	181.6760862	mPa

AS1664.1:1997-Aluminimum Structures Part 2: limit state design

Member	beam

T only

Alloy and tamper	Product	Tension		Compression	Shear		Bearing		Modulus of E
		Ftu	Fty	Fcy	Fsu	Fsy	Fbu	Fby	E
6063 T6	Extrusions	207	172	172	131	96	434	276	70000
				180					

Table 3.3(D) Page 20

T5,T6,T7,T8 & T9 only

Type of member stress	Intercept		Slope		Intersection	
Compression in columns and beam flanges	*Bc*	190.112849	*Dc*	0.99075936	*Cc*	78.6732591
Compression in flat plates	*Bp*	216.080333	*Dp*	1.20053227	*Cp*	73.7947145
Compression in round tubes under axial end loads	*Bt*	209.620466	*Dt*	6.71428412	*Ct*	trial and error
Compressive bending stress in solid rectangular bars	*Bbr*	317.096705	*Dbr*	2.61387132	*Cbr*	80.8753674
Compressive bending stress in round tubes	*Btb*	329.59479	*Dtb*	142.532382	*Ctb*	0.78029952
Shear stress in flat plate	*Bs*	120.834478	*Ds*	0.50203881	*Cs*	98.6818859
Ultimate strength of flat plates in compression	*k1*	0.35	*k2*	2.27		
Ultimate strength of flat plates in bending	*k1*	0.5	*k2*	2.04		

Table 3.4 (A) Page 21

Factor of safety	Normal buildings
φy	0.95
φu	0.85
φvp	0.9
φb	0.85
φcp	0.8
φw	0.9
φc	0.85
φv	0.8
φcc	see below

Table 3.4 (b) Page 21

kt	1
kc	1.12

RHS/SHS section properties		
Effective Length (m)	3300 mm between restraints	
Height	46 mm	
Width	25 mm	
Walls side (avg if complex shape)	0.9 mm	
Walls top/bottom (average is complex shape)	1.6 mm	CM (CANTAPORT)
Ix	66100	6.61

Iy	22300	2.23
J (Torsion constant (warp))	36000	3.6
Zx	2830	2.83
Zy	970	0.97
Area	193	1.93
Radius of gyration Rx	18.50640556 mm	
Radius of gyration Ry	10.74914143 mm	

Bending capacity

3.4.15-Compresion in beams, extreme fibre, gross section - RHS and SHS page 37

Limits (N)	659.2144054	
Zc	2830	Assumed to be Zx
S1	1.792654179	
S2	2417.766287	
	mpa	
Equ-3.4.15(1): N<S1	163.4	mPa
Equ-3.4.15(2): S1<N<S	127.0003559	mPa
Equ-3.4.15(3): S2>N	348.0668578	mPa

Add tripple to one formula

126 x2830

3.4.12 - Compression in beams, extreme fibre, gross section single web beams bent about strong axis Page 35 — **MORE ACCURATE METHOD**

limts (N)	49.41973706	Note Clause Ry=Rye Page 37 Bottom Para
Rye limit	49.41973706	Rye 66.7749405

4.9 compression in single web beams and beams having sections containing tubular portions

Cb	1	Note if Ky<1 = 1
ky	1	
rye	66.77494046	
S1	-2.570688695	
S2	94.4079109	
Equ-3.4.12(1): N<S1	163.4	mPa
Equ-3.4.12(2): S1<N<S	126.9137492	mPa
Equ-3.4.12(3): S2>N	346.3306743	mPa

Add tripple to one formula

3.4.22 Compression in components of bea- flat plates with both edges supported Page 41

WEBB

NOTE AMMEND SIDE WALLS FOR ODD SHAPES

Limit (N) (h/t)	47.55555556
	42.8
S1	38.36639146
S2	90.53212769

Equ-3.4.22(1): N<S1	190.06	
Equ-3.4.22(2): S1<N<!	198.7410129	Add tripple to one formula
Equ-3.4.22(3): S2>N	256.3999379	

FLANGE

3.4.17 compression in components of beams gross section flat plates Page 38

NOTE AMMEND TO SUIT DIFFERING TOP OR BOTTOM WALLS FOR ODD SHAPES

Limit (N) (b/t)	14.5	
H	23.2	Add tripple to one formula
S1	12.41378457	
S2	56.24597143	

Equ-3.4.17(1): N<S1	163.4	mPa
Equ-3.4.17(2): S1<N<!	159.9937862	mPa
Equ-3.4.17(3): S2>N	290.6817379	mPa

Compression capacity

3.4.8.1-Genreal compression

	k	1	
Dc	62.79993051		
S1	0.581870399		
S2	1.241183988		
λx	2.813201805		
λy	4.843387154		
	X-X	y-y	
φcc limits λ<1.2	0.409227621	-0.0171113	
φcc limits λ>1.2	0.95	0.95	

	X-X	Y-Y		
Equ-3.4.8.1 (1) N<s1	62.84567036	-2.6278072	mPa	
	145.8928571	145.892857	mPa	Red through and choise the correct one.
Equ-3.4.8.1 (2) s1<n<!	5.501644408	1.95157018	mPa	
	12.77177277	-108.34895	mPa	
Equ-3.4.8.1 (3) N>s2	8.893887077	-0.1254623	mPa	
	20.64668241	6.9655222	mPa	

3.4.8.10
Compression flat plates

Webb plates

H/t See3.4.22	47.55555556	
S1	23.13644439	
S2	39.37218	
Equ-3.4.17 (1) N<s1	163.4	mPa
Equ-3.4.17 (2) s1<n<s	106.0231909	mPa
Equ-3.4.17 (3) N>s2	88.63076354	mPa

Flange

H/t See3.4.17	14.5	
S1	23.13644439	
S2	39.37218	
Equ-3.4.17 (1) N<s1	163.4	mPa
Equ-3.4.17 (2) s1<n<s	159.9937862	mPa
Equ-3.4.17 (3) N>s2	290.6817379	mPa